ELECTRICAL REVIEW

ILLUSTRATED.

A WEEKLY JOURNAL OF

Electric Light, Power, Telephone, Telegraph and Scientific Progress.

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Electric Pumping Plant.

We are indebted to our esteemed contemporary *Industries*, of London, for the following description of an electric pumping plant: The illustration (Fig. 1) represents a compact form of combined electro-motor and centrifugal pump, manufactured by the United Electrical Engineering Company, of London. The problem which had to be solved in this instance was to utilize the existing electric light installation, in order to provide a water supply to the house which should be as far as possible automatic, and this has been done in the following manner: The cistern of the house is fitted with a float, as shown in the illustration (Fig. 2). The float is guided by two vertical wires, and a third wire passing upwards over a pulley carries a small ball, which is fixed in such a position that when the cistern is full the ball strikes a switch lever placed at A, and when the water level in the cistern has been lowered by a certain amount the ball strikes a switch lever placed at B. The connections of the motor, battery and controlling switch are as shown in the diagram. As the water level in the cistern sinks the switch B is closed, and a current passes from the terminal on the right hand side of the battery through the fine wire to the switch B, thence back to the terminal D of the controlling switch, through the electro-magnet M, and back to the second or third cell of the battery. The electro-motive force required to operate the controlling magnet is only a few volts, and there is, therefore, no perceptible sparking in the switches A and B. The magnet M, upon becoming energized, draws the horse-shoe armature from right to left, and throws the two curved prongs into the corresponding mercury cups, thus completing the main circuit through the motor, which therefore starts, and the pump begins to work. The controlling switch is now in a position to be thrown out of action when the float has risen sufficiently to bring the ball on the central wire in contact with the lever of the switch A. At that moment, which is represented by the position of the float in the illustration, the current passes through this switch and into terminal C of the controlling magnet, which it energizes, and thus throws the armature over to the right, breaking in this way the main circuit and stopping the pump. It will be seen that as long as the batteries remain charged this action is completely automatic, the water level being maintained between the limits prescribed by the position of the two switches. The current required to work the motor is 7.5 amperes, the pressure being 156 volts, and the pump is designed to lift 1,200 gallons per hour to a height of 36 feet through a one-inch pipe.

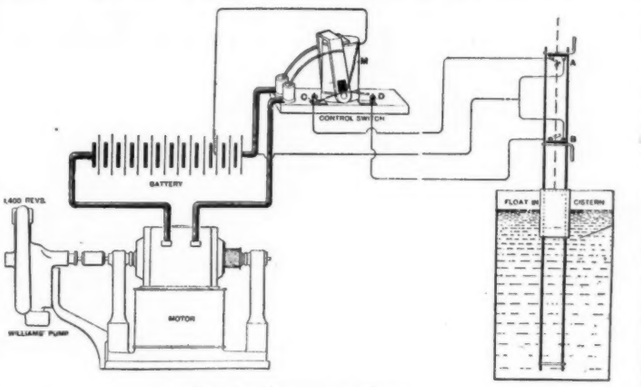


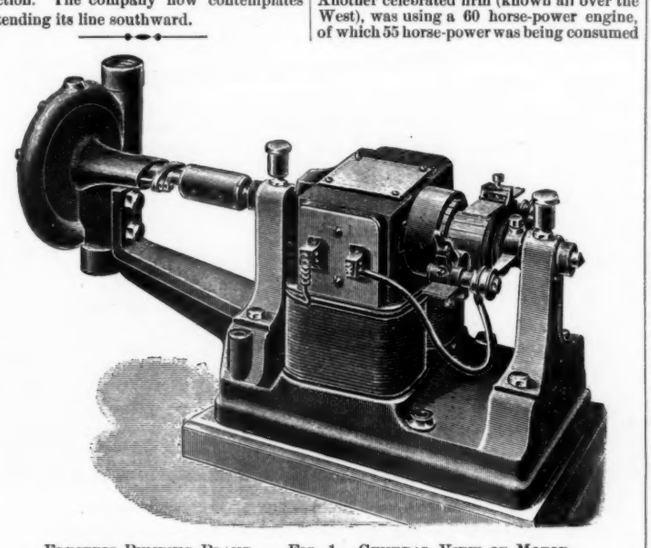
FIG. 2.—DIAGRAM OF PLANT.

An Exposition at St. Joseph.

The citizens at St. Joseph, Mo., will hold a railway, electrical and industrial exposition from September 3d to October 5th. As the Exposition Association has a capital stock of $1,000,000, and as St. Joseph is peopled with wealthy and progressive citizens, there are many reasons why the exposition should be a success.

Telephone Work in Mississippi.

It is learned from Superintendent Fowler, of the Southern Telephone Company, that the company now has stations at Bolton, Clinton and Jackson, in addition to its former stations, New Bell, Bovina and Edmondson on the A. and V. Railroad, which afforded telephone service at every station on the A. and V. Railroad, between Vicksburg and Jackson. The company is now building a line to connect Vicksburg with all towns on the east bank of the Mississippi as far as Greenville, and has a large force employed. The line from there to Yazoo City, *via* Satartia, will be restored to perfect condition, and stations added at all important places on the line. A new cable will be laid across Yazoo river, for the benefit of the Greenville connection. The company now contemplates extending its line southward.



ELECTRIC PUMPING PLANT. FIG. 1.—GENERAL VIEW OF MOTOR.

The Omaha and Council Bluffs Railway and Bridge Company are progressing rapidly with the electrical equipment of the recently purchased horse car lines in Council Bluffs. For the operation of such lines they have purchased ten additional motor trucks and two generators from the Thomson-Houston Electric Company.

Reckless Waste of Steam Power.

The Westinghouse Machine Company recently sent experts equipped with the necessary instruments to visit a number of prominent manufacturing establishments in various parts of the country to test the consumption of power by each machine. As a rule, permission was readily obtained from the owners, they seeming much interested in the results. The results are amusingly indicative of the carelessness shown in such matters. Nearly all were found to be wasting one-half of their engine's power in doing other than useful work. One prominent establishment was wasting 65 per cent. of its fuel and power; another was wasting 73 per cent., thus leaving only 27 per cent. of the engine's power to earn money with. Another celebrated firm (known all over the West), was using a 60 horse-power engine, of which 55 horse-power was being consumed in dead work; thus leaving just five horse-power with which to produce goods for sale.

The gas company at Rushville, Ind., has helped along the cause of electric lights by its bitter opposition to them. On account of the action of the gas company in fighting the electric company, many people threaten to have their gas meters removed.

The Edison Phonograph Toy Company.

A special meeting of the Edison Phonograph Toy Manufacturing Company will be held at Portland, Me., on July 3d, to act upon a proposition to increase the capital stock from $600,000 to $1,000,000, that is, from 60,000 to 100,000 shares, and to give the directors authority to dispose of the same. Accompanying the notice is a circular and call for proxies, signed by the directors, which says:

The increase of capital recommended by the directors does not involve any assessment upon or expense to the present stockholders, the existing capital being $600,000, fully paid. It is confidently expected that negotiations now in progress, will, when successfully completed, not only largely increase the earning capacity of the company, and thus add materially to its strength, but will also enhance the market value of the stock. These include an arrangement with Mr. Edison, whereby the company secures his services in manufacturing for both the foreign and domestic markets, and also improvements and new inventions already made or to be made by him during the next five years. These are believed to be of great value. The negotiations also contemplate a substantial reduction on his part of the amount of royalty to which he is entitled under existing contracts. For all this it is proposed to issue to him a portion of the new stock, he thus becoming closely identified with both the financial affairs and the general operations of the company. Under a contract made some time ago, responsible parties had undertaken the manufacture and sale of dolls in foreign countries, and the establishment of factories and agencies connected therewith, and had necessarily incurred considerable expense in models and machinery. To successfully complete the negotiations between the company and Mr. Edison, it was found necessary to cancel this contract, and it was deemed advisable also to secure the models which are thought to be of great utility and value in the business of the company. This has been done, and thus all matters connected with our foreign business revert to the company. In return for this, another portion of the proposed increase of capital is to be used. It is expected that the entire manufacture of dolls for the trade of the world will be under Mr. Edison's personal supervision. Your directors believe that the importance of this to the company in a pecuniary point of view has not been overestimated by them. It is intended to issue for all these purposes 24,000 shares of the new stock, retaining the balance of 16,000 shares in the treasury for the present, to be used in obtaining other new inventions and improvements, and in developing the business of the company as the future may render necessary. Your directors ask your co-operation in this important matter, assuring you that not one share of stock is to be issued except upon conveyance to the company of what they believe to be a full equivalent.

A New York electrician about to cross the ocean is said to have sent a phonograph to Marshall P. Wilder, the diminutive humorist, asking him to talk into it and return it so that he could have the fun on tap during the voyage.

Electrical Tanning.

The electrical tanning process has been attracting much attention of late, and the following is a description of its operation from the pen of a scientific tanner, published in the London *Boot and Shoe Trades' Journal*. The correspondent writes as follows:

"I am far from believing that we have got beyond the ABC of electricity, but we have surprising statements of its effect in manipulation of hides and skins. The results I will refer to in the latter part of this letter. I have gone into the published *modus operandi* very carefully, and to test my knowledge I have consulted an electrician as to the effect of electricity and its action on the liquors and the belts. The action of electricity upon water results in throwing the oxygen in one current and the hydrogen in the opposite. In like manner it will cause tannic acids to separate and circulate in distinct chemical volumes, water, being a weak conductor, receiving its power from metallic rings fixed inside the drum. These are connected by a wire passing through the case of the drum to corresponding rings around the outside of the drum, these being in constant contact with wires proceeding from the batteries where the electricity is generated. The tank is divided into two compartments to hold the liquors, the compartments are provided with regulating cocks to convey the liquor by and through tubular trunnions into the interior of the drum; the inside walls of the drum are studded with projecting pegs, and have four manholes at right angles for putting in and taking out the hides, and stop-cocks or valves are suitably fixed for drawing off the liquor when required. The conductors from the terminal of the electric generator are led first to an overhead beam, and then descend to the summit of two posts—one on each side of the drum—where they have contact with the metallic rings on the exterior of the drum, and communicating by wires, as above described to the interior.

THE OPERATION IS DESCRIBED

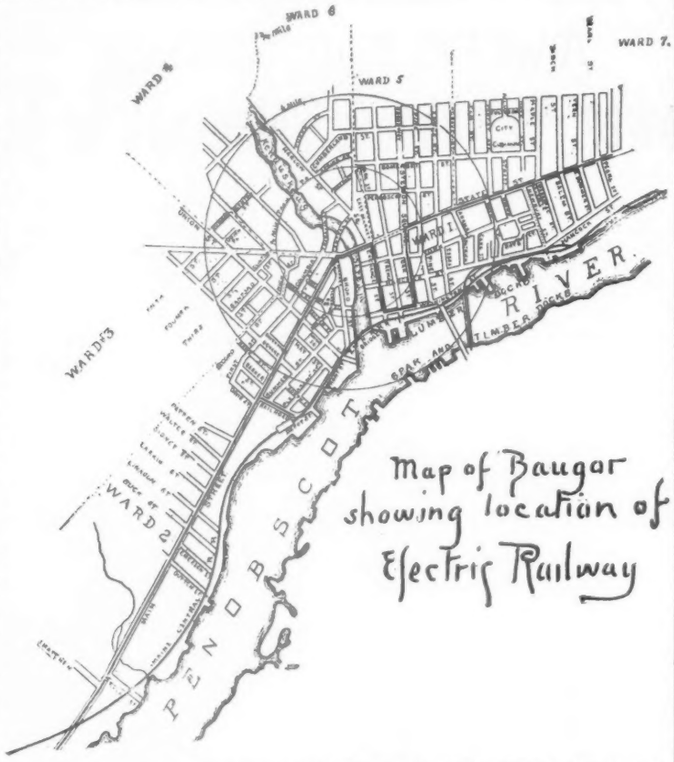
as follows: If the apparatus is of the capacity of 1,200 litres (*i. e.* 262 gallons) it may be charged with 500 kilogrammes (1,125 lbs.) of hides, and then the manholes being tightly closed, it may receive the tanning liquor, consisting of about 25 kilogrammes of tanning extract at a strength of 20 Beaume and 280 litres of filtered water (65 gallons). The drum thus charged is caused to revolve at the rate of nine or ten revolutions per minute; the electric current is then made to pass through its contents, from the one ring to the other, and, at the same time, from one of the compartments of the tank about 2½ litres of essence of turpentine (four pints and a half) are admitted by the tubular trunnion into the drum. After the drum has revolved for 12 hours for ordinary hides, or six hours for very light skins, the electric current is cut off, and a second dose of tannic extract is admitted to the drum while it continues in motion, the revolution being continued for about 80 hours for ox hides ordinary, 72 hours for light hides, and 48 hours for calf skins.

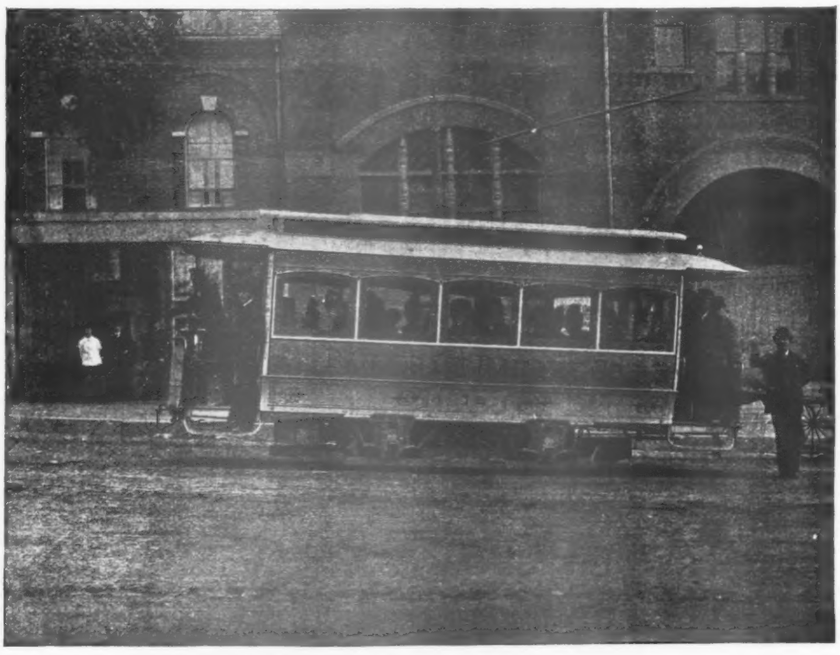
The tanning should then be complete; when this is effected as above described, the drum is stopped, and the liquor run off into a closed receptacle. About an hour after running all the liquor out two of the man-holes opposite each other are opened, and remain so for about two hours to allow evaporation to escape; the hides may then be withdrawn and hung up for several hours for airing. If for dressing they may then be passed to the currier, or, if for sole leather, be left in the hands of the shed man.

THE PROSPECT OF RESULTS.

We must look at these in a practical manner as to tanning, and admit that if the basis is sound, and the figures not erroneous, it will indeed produce a revolution in tanning. The reduction in time of manipulating the pelts no doubt is great. The quantity of tanning material (1 cwt.) appears fabulously small, while it is stated the same outcome is produced as by ordinary tanning; well, as the saying is, "we shall see what we shall see." If the company work the patent and accomplish what they state, it must be a great success; but we must consider the figures, 1,125 lbs. of hides ordinarily should produce 562 lbs. of leather. How is this done, except it be by amalgamating a large quantity of tanning with the pelt, not for the purpose of creating weight, but with the object of producing leather? If 1,125 lbs. of green hides can be made into passable leather with 112 lbs. of tanning extracts, it will surprise tanners who used to say it required six pounds of oak bark to make one pound of dry leather. In the prospectus it states, on the authority of Mr. Blackman, that the cost for materials (under usual modes) is 3½d. to 4d. per pound of leather, which about confirms general cost, and what is most important is the cost of tanning by aid of electricity. So long as these figures indicate the quality good, and the outcome anything approaching that procured by ordinary modes, the cost taken upon the data given will only be about 25 per cent. of present cost, instead of 50 per cent. of the cost of even the cheapest tannages.

I am not exaggerating when I say the system will be keenly scanned when it is in operation. As an advocate for improvement in tanning, as well as in other trades, I hope to see some good reports of the electric, but as a practical tanner, I must own I am sceptical about the quantity of material named being more than enough to barely color the pelts through, and certainly not sufficient if it were entirely absorbed, it could not produce the usual outcome by 20 per cent. or more. As a trader of some experience, I would say the great desideratum is excellence of quality, at a lower cost if possible, leading to greater demand for our manufacturers. Save as much time as possible, but with it all excel, and there will be no lack of purchasers at a fair profit. I have endeavored, as I commenced, to take an impartial view of this system, touching each point with some of the bearings, knowing it will interest many in the trade, and I hope, benefit most of us.





THE BANGOR ELECTRIC ROAD.—THE MAIN STREET GRADE.

To Enlarge Its Building.

The Edison Electric Illuminating Company, of Fall River, Mass., has begun to enlarge its present quarters. The brick building used as an engine house will be extended to Hartwell street, and the little wooden building used as an office will be removed. A pair of dynamos of 1,200 light power and an engine to run them will be put in. The company's office will occupy the front of the building. At present the company is running two pairs of 600 light machines and a pair of 300 light each, or 3,000 lights in all.

To Use the Water Power.

A despatch from Bangor, Me., says: Bangor is happy, that is everybody in Bangor except the old electric light company, since the inauguration of the new system of lighting the streets has gone into effect. Our progressive Bangor mayor has a new plan which will be of importance to the city if carried into effect. His plan is to utilize the large amount of power now running daily to waste at the city's works to charge storage batteries with electricity. The old hook and ladder building can be used for that purpose. The expense of securing power has been a drawback to the location of small industries here and this method of securing power it is believed will greatly add to the facilities in our city. Mayor Bragg is alive to the interests of the city, and will leave no stone unturned to enhance them.

Pittsburgh, Pa.— The Equitable Telegraph Company, to operate in this and Westmoreland County, was chartered with a capital of $2,000. The stockholders are R. B. Brown, Reuben Miller, James Hemphill, A. F. Keating, C. H. Zug and George Trautman, of Pittsburgh; J. S. Brown and L. M. Morris, of Allegheny, and F. B. Robinson, of New York.

New Orleans, La.—The Electrical Traction Company; incorporated to manufacture and operate electrical machinery of all kinds; and to manufacture, lease and operate cars for street railroads to be run by electricity. One of the cars of the company has already been running on the "Snake Line" road for several weeks.

Portsmouth, N. H.—The Electric Rapid Transit Company has been organized and the following officers elected: President, Gustavus Kinsman; vice-president, O. E. Smith; secretary and treasurer, J. W. Dane; directors, Gustavus Kinsman, O.E. Smith, J. W. Dane, G. A. Whipple and Joseph Webster Dane. The company is composed of Massachusetts and New Hampshire capitalists. At the close of the meeting another company was organized, to be known as the Boston Electric Stock Indicator Company, composed of the following well known Massachusetts gentlemen: E. P. Mendum, J. W. Marshall, C. O. Lees, F. K. Hooper, A. O. Marshall and D. W. Cook.

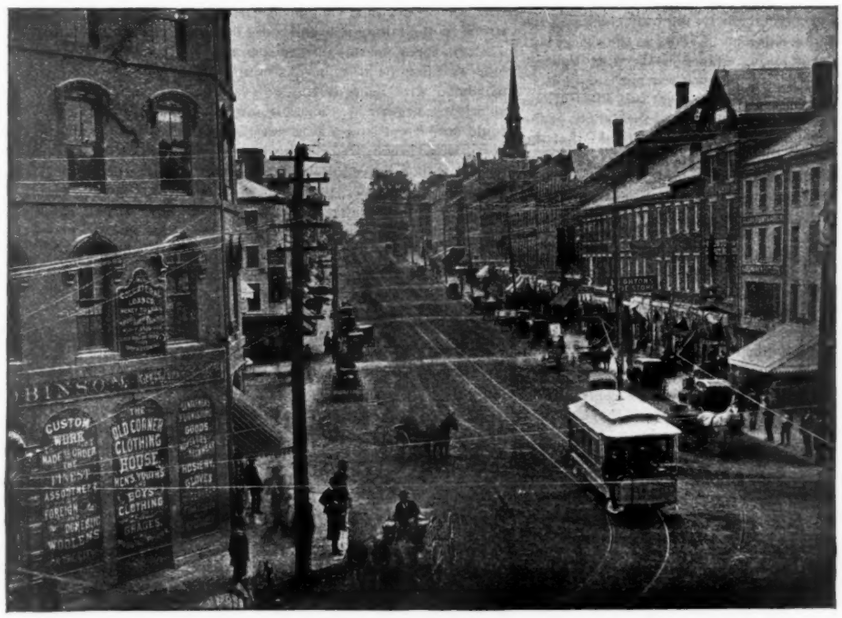
—— At the annual meeting of the Milford, Mass., Electric Light and Power Company, held last week, the report of the treasurer showed a very encouraging outlook for the company, as during the past year there has been a large percentage of reduction in the expenses, while the receipts were much larger than in former years. The annual election of officers took place, resulting as follows: Clerk, A. S. Trowbridge; treasurer, R. B. Greene; directors, W. F. Draper, John P. Daniels, G. M. Greene, C. W. Shippee, C. W. Wilcox, E. B. Bancroft, George A. Draper, J. F. Stratton, H. E. Fales, J. Allen Rice, G. G. Cook and T. C. Clifford.

Electric Railway, Bangor, Me.

We illustrate herewith the new electric railway which has been put in at Bangor, Me., using the Thomson-Houston system. One of the cuts shows a car on Main street hill, opposite the Opera House, a grade of seven per cent., and the other a car in West Market Square, the very heart of the city. The road at Bangor is three miles in length, single track, with three turnouts, and contains many curves and grades, the most severe of which is a curve of 35-foot radius which occurs on a grade of seven per cent. There is one stretch of the road, about three quarters of a mile in length, which has five curves and an average gradient of five per cent. No difficulty, however, is experienced here, and the cars climb these grades with a scarcely perceptible diminution of speed. The nature of the overhead work necessitated by these can readily be seen from the accompanying map on which the situation of the road is indicated by a heavy line.

There are four 16 feet cars, made by the Newburyport Car Manufacturing Co., which are handsomely furnished and equipped with two 15 h.p. Thomson-Houston motors. Three cars are in operation from 6 a.m. till 11.30 p.m., the fourth being held in reserve for special occasions

The power plant consists of one 30 h.p. Thomson-Houston generator, with the necessary station fittings, which is driven by a 14 x 13 Armington & Sims engine running at a speed of 250 revolutions per minute. This is the only tramway which has ever been constructed in Bangor, and it has from the very start given the utmost satisfaction; but one schedule trip having been missed since the day of starting, May 21st. The travel has been very heavy, averaging 1,600 passengers per day, and on one day 3,000 were carried by three cars. The success of the road has been such that extensions have been asked for in many parts of the city.



THE BANGOR ELECTRIC ROAD, WEST MARKET SQUARE.

The Electric Road at Salem, Mass.

The Committee on Streets, of the Salem City Council, has recommended the passage of an order granting the Naumkeag Street Railway Company the right to run its cars by the single trolley overhead electric system, under a series of 13 conditions, one of which provides that the company shall file a bond for $10,000 with good securities to hold the city harmless in the event of any liabilities by the construction and separation of such line. The Board of Aldermen are to have full control of the construction of the line, the approval of the poles and quality of the wires; the engineers of the fire department or the Inspector of Buildings may cut the wires of this overhead system when necessary, without any liability on the part of the city. The Aldermen may order the removal of any poles or wires and the company shall remove them, and restore the street as good as it was before their erection. No poles or wires shall be erected on Washington square between Essex street and Andrew street until the Naumkeag Company has complied with the order passed June 20, 1888, regarding the location of its tracks. The order was laid on the table.

—— The Sioux Falls, Dak., Electric Light Company is now furnishing 1,300 incandescent lights.

An Electric Railway for St. Paul.

A dispatch from St. Paul, Minn., of recent date, says:

"Archbishop Ireland and Thomas Cochran, Jr., have just signed a contract with Thomas Lowry for the construction of an electric street railway from six to ten miles long, from the central part of the city to Creton street and the Summit avenue boulevard on the Mississippi above the city, giving a bonus of $250,000 for the road. At the terminus will be built an addition to St. Joseph's Hospital, St. Thomas' (Catholic) Seminary, a Baptist college, and also, probably, a Lutheran institution. The company backing the two gentlemen named contemplate the establishment of a new and fine suburb, and expect to expend several millions in carrying out their scheme. In the contract Mr. Lowry agrees to do away with horse-cars entirely, substituting therefor an immense electric motor system."

The Universal Electrical Exhibition at St. Louis.

To the Electrical Fraternity:

The general management of the Universal Electrical Exhibition, to be held under the auspices of the St. Louis Exposition and Music Hall Association, commencing September 4, 1889, and continuing for a period of six weeks, has been placed in my hands. The Association is prepared to make this electrical exhibit the greatest that has ever been held in the United States, and for that purpose unlimited facilities are offered for the operation and display of the products of the electrical and mechanical world.

There will be no charge whatever made for space or power, and all articles will be returned on the railroads free of cost. There is 75,000 square feet of floor space set apart for the exhibit, and every aid will be given exhibitors to make an attractive display.

As an educational medium, and as a means of putting the products of electric science in a business way before the people of the entire south and west, and southwest (a grand army of buyers in themselves), this exhibition offers unexcelled advantages.

Gilmore's famous band will furnish music during the entire six weeks of the exposition, and the most elaborate excursion arrangements have been made. From the phenomenal success of the St. Louis Exposition, held in this building during recent years, it is estimated that at least 700,000 people will inspect the exhibit, and it will be the first occasion in this country where so large a field for electrical work has been presented to the electrical people.

Application blanks and any information that may be desired will be cheerfully furnished.

FRED. H. WHIPPLE,
General Manager.

A Brush Plant in a Newspaper Office.

In the course of an illustrated article describing its new building, the Cleveland *Plain Dealer* says:

"One of the most valuable and satisfactory improvements in the new building is the incandescent electric light, taking the place of gas throughout the entire establishment. When planning for the new office a contract was entered into with the Brush Electric Company of this city for one of their celebrated incandescent plants, a 200-light dynamo machine to be placed in the press room, to be operated by the large engine that furnishes power for all the other machinery in the building. The machine, provided with all the latest improvements invented and patented by the Brush Company, was put in position last week. The wires, having the perfect insulation for which this company's work is noted, were run into every department of the paper from the editorial rooms and composing room on the fourth floor to the the press and stereotyping rooms in the basement, each floor having a separate switch. In the counting room were placed hidden wires, the corded wires dropping from the ceiling; while over the balance of the building the casing for the wires is equally perfect. From the moment the belt was tightened upon the pulley and the dynamo began its rapid revolutions until the present time the building in some or all of its parts has been constantly flooded with a beautiful mellow and clear light. Every one of the 175 glass lamps has burned in the most perfect manner, demonstrating to the fullest degree that a good incandescent electric plant, if controlled by steady power, is the superior by many degrees of all other forms of illumination for either indoor or outdoor lighting. No one can better appreciate the advantages of this light than the compositor who has experienced the uncomfortable and weakening effect of gas or oil while working all night in front of a type case."

An Electric Railroad for Saratoga.

Considerable excitement has been created in Saratoga over the idea of an electric railroad to Geyserville. Major J. L. Butman is the projector and already has his plans. He says he has secured the approval of every real estate owner along the proposed line, and will run the road on the Thomson-Houston system. It will not be put through the pleasant drive way, Ballston avenue, but 360 feet east of the drive, which would be the continuation of Clarendon avenue. Mr. Butman states that the road will be built immediately, and that he will furnish the required capital. If nothing hinders it will be running August 1, at five cents a trip. It will be a summer railroad only.

Racine, Wis.—The Wisconsin Lead and Zinc Company, of Racine, capital, $1,000; incorporators, J. E. Dodge, F. M. Fish and J. M. Osgood.

Chicago, Ill.—Randall Car-Heating Company, Chicago; for manufacturing; incorporators, Gilbert E. Porter, William H. Randall, W. H. Porter.

Lincoln, Ill.—The Lincoln Electric Light and Power Company, of Lincoln; capital, $20,000; incorporators, E. D. Blinn, J. T. Hoblit and A. J. Aldrich.

Chicago, Ill.—The American Aluminum Company, Chicago; to extract from kaolin and manufacture aluminum; capital, $1,000,000. The incorporators are Thos. Charlton, Edgar C. Price and Chas. W. Vance.

Salem, Ore.—Marion County Improvement Company; W. H. Byars, W. H. Odell and Alonzo Gesner, incorporators; capital stock, $75,000; object to construct and operate a motor line from Salem to Silverton.

Santa Fe, N. M.—The International Construction Company, of Chicago, Ill.; capital stock of $10,000; incorporators, Lawrence P. Boyle, John Ritchie, John D Jones. John Schofield, of Deming, is agent.

Dundee, Ill.—The Dundee and Carpenterville Electric Light Company, location Dundee; for the purpose of furnishing electric light; capital stock, $6,000; incorporators, William Fay, Arthur Klott and Barry Dorley.

New York.—The Standard Electrical Subway Company, to construct subways; incorporated with $250,000 capital, to do business in New York City. John J. Wilson, Edward Bayard Halstead and Harvey L. Kennedy, incorporators.

Buffalo, N. Y.—The auxiliary fire alarm known as the Gamewell system; C. W. Miller, Henry Altman, H. C. Palmer, H. T. Ramsdell, Frank Coit, D. N. Lockwood; the capital to be invested is $100,000; C. W. Wilder, of New York, is the agent.

Indianapolis, Ind.—The Muncie Street Railway Company filed articles of incorporation, the capital stock being $150,000; F. E. Smith, Elias Lyman, J. G. Reed, C. E. Shipley, C. R. Hayward, F. G. Brunnell and S. C. Goshorn are the directors.

Davenport, Ia.—The organization of a local Electric Street Ry. Association completed, and the following officers elected: Thomas J. Evans, of Omaha, Neb., president; H. E. Teachout, of Des Moines, Ia., vice-president; W. R. Moore, of Moline, Ill., treasurer; Dr. W. L. Allen, of Davenport, secretary.

Helena, Ark.—The Helena and Old Town Telephone Company; capital stock all paid up, with J. T. Brame as president and J. W. Clopton, secretary. The board of directors consist of J. T. Brame, J. W. Clopton, M. K. Key, R. B. Higgins and Joel Higgins, Jr., and A. B. McGonigle. Construction work will begin immediately.

Plattsmouth, Neb.—The Plattsmouth Electric Lighting Company; the object of the company is to furnish light, heat and power for the citizens of Plattsmouth; the capital stock is placed at $30,000, divided into shares of $300 each, which are to be fully paid up three months from date; the incorporators are Otis C. Ballau, Carlos D. Jones, Justin G. Reshey and Emmil L. Oppeman.

Portland, Me.—The Woodward Underground Electric Light and Cable Company has been organized with a capital stock of $2,000,000; paid in, $125; par value of shares, $25. These are the officers: President, Arthur T. Woodward, of Lynn, Mass.; treasurer, Albert W. Brown, of Boston, Mass.; directors, Arthur T. Woodward, Albert W. Brown, Osnus Phillips, Nelson J. Botsford, Chas. Otis Marshall.

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☞ No attention will be paid to communications without the *name and address of the writer.*

We invite correspondence from Electricians, Inventors, and the Telegraph and Telephone fraternity and those engaged in Electric Lighting, on matters pertaining to electrical and scientific subjects, and all facts of special interest in connection therewith.

We extend to manufacturers of electrical apparatus an invitation to send to this office any and all facts concerning their business which will be of interest to the public. We make no charge for publishing news.

Subscribers can at any time have the mailing address of their paper changed by sending both old and new address.

NEW YORK, JULY 6, 1889.

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The new Bureau of Public Lighting, a branch of the Department of Public Works of Philadelphia, began operations on Monday, July 1st. Under its control will be all the electric lights in the city. The office of city electrician is already created in most of our cities, and the effect of intelligent supervision of city electric lighting cannot but prove beneficial to both sides concerned.

The current numbers of our esteemed contemporary, the *Engineering and Mining Journal*, which is publishing the exhaustive article on the "Metallurgy of Steel," from the pen of the well-known authority, Mr. Henry M. Howe, contain that portion of his work which is devoted to the subject of electric welding, and comprise much interesting information and some valuable tables of statistics relating to the subject.

Several items in our electric light and power columns this week show a most gratifying condition of things in regard to export trade. But, while much of such business is reported, the field is large and should be even better occupied.

It is said that Park Row looks wider now that the telegraph poles are gone, and this is adduced as an excuse for their removal. In our opinion something more tangible than an optical delusion should be necessary before public service is interfered with.

It is a great pity that the City of Baltimore, which has always been to the fore in matters of electrical improvement, should now adopt a cable system for her street railway lines, when in 40 or more places in this country electric roads are giving much more satisfactory service.

We are indebted to the publisher of the N. Y. *Evening Post* for a copy of his "Postal Dictionary" which, is as the name indicates, an alphabetical handbook of postal rates, laws and regulations for all who use the mails, and as may be easily imagined, is a most convenient adjunct for any office.

Manchester, N. H., is the latest "best lighted city in the country," and an eminent authority is quoted to prove it. If these "best lighted cities" contiuue to crop out so unceremoniously, the only chance of distinction will soon lie in being the second best or even taking a place as the worst lighted.

Some interesting electrical observations have already been made at the summit of the Eiffel tower. It has been found that the tower is a marvellous lightning conductor, and that were the lightning to strike it, not only would there be no damage done, but the visitors themselves would not notice the shock.

The Naval Board of Annapolis Academy, in a report just made, suggest that, owing to the extensive application of electrical appliances on board ship, there ought to be an electrical plant, similar to those in use on the best equipped vessels, at the Academy. An excellent suggestion, and one that should be carried out at once.

The right spirit was shown by the Albany *Journal* during the electric railway hearings in that city, which went to the trouble and expense of illustrating the fallacy of the arguments against the introduction of electric power on the ground of disfigurement of the streets. Views were gotten up showing the existing ornaments of the telephone and telegraph wires, beside which the almost indiscernable overhead wires appeared not worth fighting about.

The work of Mr. A. R. Foote, chairman of the national committee on State and municipal legislation of the National Electric Light Association, is meeting with well-deserved success and encouragement in his work. The printed "plan of work" for the committee was heartily endorsed upon its appearance, and on the first call 19 nominees accepted the appointment as members of the committee for their respective States. The immediate acceptance of nominations will greatly facilitate the work and allow the committee to start its useful work immediately after the Niagara Convention.

Mr. A. V. Garratt, secretary and treasurer of the National Electric Light Association, makes the official announcement of the tenth convention at Niagara Falls, August 6th, 7th and 8th. The sessions of the convention will be held at the Casino, and delegates will stay at the International Hotel. Mr. Benjamin Rhodes may be addressed at Niagara Falls for space for exhibits. The announcement is also made that railroad tickets at reduced rates and seat checks for the special limited Pullman train which will leave New York August 5th, may now be obtained at the Association headquarters, 18 Courtlandt street, New York.

The town of Bristol, R. I., has been stirred to its very core by the trimming of the trees which became necessary in order that the streets and sidewalks should receive some benefit from the electric lights. Several gentlemen were so worked up over the curtailment of the foliage that they counseled buying the electric light plant and throwing it in the river. It is needless to say such a course was not adopted and the electric light is doubtless in Bristol to stay. No city can be too car.ful of its green trees and with proper care they need not be seriously interfered with on the introduction of electric lights. It is usually the want of such care that brings into existence such controversies as that in Bristol.

Lansingburgh, N. Y., has been the scene of the latest conflict between the private citizen and the pole erectors. It seems the franchise granted the Troy and Lansingburgh Street Railway Company gave the privilege of erecting poles without specifying what their locations should be. All went well with the erection of poles until poles were set in two places in front of lots owned by a citizen who objected strenuously, so strenuously in fact that his men emulated the example of the hirelings of New York's Mayor, and chopped down the poles. Not being expert in such matters the operations were attended with disaster for a telephone wire was broken, and an innocent passer by struck by the falling pole and badly bruised. The man threatens suit for damages and another suit may be brought on account of the telephone wire being down, as a call for a veterinary surgeon at some distance away could not be sent and the life of a valuable horse thus jeopardized. The end of the matter is not yet and the circumstances should prove a lesson, that pole franchises should designate locations and thus responsibility could be placed in an affair of the sort.

ELECTRICITY USED IN RAPID TRANSIT.

On Wednesday evening, at a meeting of the American Institute of Electrical Engineers, Mr. Leo Daft read a paper on "Some Recent Electrical Work on the New York Elevated Railroads, and its Bearing on the Rapid Transit Problem." The paper was of more than usual interest, for the reason that it laid all theoretical considerations aside, and dealt purely with the results of the recent experiments on the Ninth avenue elevated road; the speed and cost of operating trains by electricity was directly compared with the ordinary method of steam locomotion. The results of Mr. Daft's efforts show that the electric locomotive, weighing ten tons, can do the work of the steam locomotive of 18 tons, and that it is possible, on the present elevated structures, to operate trains by electricity, at a high speed. The unfortunate fact that Mr. Daft had, in his experiments, no equivalent of the air brake used on steam propelled trains, and was obliged to shut off his current three blocks before he reached each station, prevented him from running trains on exact schedule time. We understand that Mr. Daft is now preparing an electric brake which will give perfect control of the train. This paper will be widely read by all those interested in this most pressing question of rapid transit in great cities.

NEW PUBLICATIONS RECEIVED.

Arc Electric Light is the title of a small 12mo. of 15 pages, by City Inspector Haskins, of Chicago, issued by the Central Electric Company, 42 La Salle street.

Mr. Haskins has given us in this little brochure, what seems to be just the thing for non-electrical people—an explanation of how the arc light is produced, without confusing technicalities and equations. His comparisons and illustrations are simple, yet forcible, and the whole is readable to the expert as well as the novice.

Copies may be had by mail on application to the Central Electric Company, 42 La Salle street, Chicago, with stamps enclosed for postage.

SOME MISLEADING STATEMENTS.

The New York correspondent of the Boston *Transcript* in an interesting letter concerning the new course in electrical engineering at Columbia College, which will be confined to graduates of engineering colleges of high standing, makes the following observations:

"On the other hand, it is urged that it will be difficult to get together graduates enough to make the course a success. The men who enter the school of mines and similar schools are usually poor, in comparison with ordinary undergraduates, and find it hard enough to spare four years in learning their profession. For most of them, two years' study, in addition to the extra fees, would be out of the question. If on graduating they wish to take up electrical engineering, they now go into Edison's laboratory or workshop, or the workshop of the Brush or the Westinghouse or the United States Electric Light Company, and pick up their electrical education while earning $100 or $150 a month as assistants. Such a method of combined work and study with remuneration they will probably prefer to further collegiate attendance, however instructive; and if so, the only graduates who will care to take an electrical course will be men who have only amateur interest in the subject, or who are not clever enough to get such positions. From this point of view it would be wiser to found a four years' course in electrical engineering parallel to the other seven courses, following the precedent set by Lehigh University and Cornell." Without discussing the merits of the question, one or two of the above statements demand attentention as misleading at least. It is fair neither to the companies nor to the graduating students to let the statement go forth that for the asking a graduate of an engineering college may enter the laboratory of a Brush or an Edison, and there receive from $100 to $150 a month as an assistant, while "picking up" his electrical education. In the first place, the training received during a collegiate electrical course and that received in a laboratory cannot be classed as one and the same thing. Best results are reached when the student supplements his scientific and electrical studies with a practical workshop course. Now, in several instances coming under our notice, graduates of some of the best known and highest grade electrical courses have been glad to accept laboratory positions at salaries—well, hardly up to these quoted—and where the authority for the statement that graduates simply, of colleges, inferentially without any electrical training, can so easily command the salaries quoted, is a question. The fact that good material commands much less salary is by no means disparaging to the business, nor does it cast any reflections upon the manufacturing companies, but simply illustrates that the value of laboratory training in its place is realized, and demand and supply come in, as always, to regulate prices. It is used as a stepping stone to something better and more remunerative. It is rather odd that the correspondent of a Boston paper in writing on this subject and making comparisons as he does, should so utterly ignore the Massachusetts Institute of Technology, which is one of Boston's prides, and whose electrical course has long been recognized as one of the best in the country. Were the *Transcript's* correspondent's statements to be widely circulated throughout our scientific colleges, the occurrence of badly swelled heads among our young bachelors of arts and sciences (isolated cases of which are even now known to exist), would become unbearably common.

A third edition of Mr. Robert Luce's admirable little book on "Writing for the Press" has been issued much enlarged and improved. In its former shape it was a valuable manual for editors, reporters, correspondents and printers, and its enlargement will also doubtless extend its field of usefulness. It is issued by *The Writer* Publishing Company, of Boston.

ELECTRICAL NEWS.

Boston, Chicago and Other Points.

OUR CHICAGO LETTER.

A Spanish Invention.– It has been said that for a period of over one hundred years the Spanish people invented nothing but the spur with which the senor goads his riding animal, and that the mandolin was originally but a badly made guitar. Either by accident or intention, however, a recent curiosity from the land of mules and ponchos is worthy of notice. Imagine a box of light material, a foot long or so, with holes along the sides for ventilation—an one hundred cigar box, if you like. Inside this is a brass strip, permanently fixed. On the top of the box, a little drum with the head knocked out, and two wires strung guitar fashion across this drum frame. The tension of the wires forcing the drums downward, holds a push button open. No! you are mistaken; it is not a burglar alarm—it's a thermostat. When the room is gradually heated the slack in the wires is compensated for by the expansion of the bar. But when a sudden heat is developed, the wires slacken up suddenly and the button closes. After the exhibit, the normal condition is again assumed, and it is ready for another test. One that I know of has been tested many times, and it is as sure on fire as a terrier is on burglars.

A gentleman told me the other day that in a building on Madison street, where there was a connection with the mercurial alarm wire to the insurance patrol house, the red-shirted fire-worshippers made two or three hasty calls on the occupants of the building, all cocked and primed with soda water attachments and tarpaulins, to put out a fire which did not exist. After much of that sort of experience, flavored with lurid quotations, investigation showed that the lead pipe through which the cable ran was in the rats' way, and these industrious nibblers had reduced the size of the obstruction by gnawing off the lead, and every now and then, when one of the larger animals—presumably an alderman—passed that way, he crossed the wires and turned in an alarm.

A something similar case I once knew in Canada, where a lot of children, one rainy day, playing in a loft where the telegraph office loop ran—there was but one line went through the town—camped on and crossed the wires, keeping the office cut out until the operator traced the loop some six miles out to the main road hunting a cross, and when he finally discovered the trouble he was rather more angry than a whole fire department ever was at a single rat.

Fire.—An alarm of fire was turned in at 5.05 A. M., yesterday, which had been burning long enough when discovered to seriously threaten the entire neighborhood at the corner of Clinton and Van Buren streets. The building, six stories and basement, was occupied by a large variety of industries, and among these were E. A. Sperry & Co., manufacturers of electrical specialties, mining apparatus and other machines, and the Belding Motor Company.

The locality is largely electrical. Within pistol-shot to the south, only 200 feet or so, the magnificent and huge Western Electric Company's works are located. Nearly opposite, on Clinton street, the Sperry Electric Company's factories are situated, and but a short distance to the northwest are the works of Cowl & Vandenburg, also manufacturers of electrical machinery.

Sperry & Company's loss was complete. Insurance only partially reported so far, $500.

The Belding Motor Company's loss was, as nearly as can now be estimated, $55,000 to $60,000, on which there was $23,000 insurance. All drawings were saved, as duplicates had been made to provide for possible emergencies. The company has leased the third and fourth floors of 128 to 130 South Clinton, and will be running again in a week or ten days.

Telegrams in Law.—In the Cronin murder case, which the Chicago Grand Jury is daily probing, the legal investigation demanded the production of all telegrams to and from certain parties in the W. U. Co's. files. Wm. E. Bell, chief clerk, refused to deliver them on the order which the learned pundits call a "*subpoena duces tecum*," whatever that may mean. Contempt of court was threatened and imprisonment promised as the reward of this contumacy on the part of the chief clerk. The order was drawn and served on Mr. Bell, who then explained through his attorney that the refusal was not intended to antagonize the law, but to secure the proper compulsory order from the authorities, as without such an order the company would be liable to a fine of $5,000 for the criminal offense of making a private dispatch public. The Grand Jury now gets the messages, which are those of Sullivan, Coughlin, Mooney and Melville, or any assumed names or aliases they may have used in telegrams.

And Again.—A telegraph operator at Kansas City was blacklisted by the company for joining a telegrapher's protective association. He could obtain no employment, and he sued for $25,000. The judge held that these notices between superintendents were privileged communications, and the plaintiff was non-suited in consequence.

Specialties.—Jno. R. Fletcher's electrical specialties, hangers, insulators, pulleys which are slect proof, and all that sort of thing, have become as household words to the electric light people. The Electrical Supply Company here has just issued a special circular announcing the sole agency for the above articles at 171 Randolph street, Chicago.

One-Hand Philosophy.—One of two things is inevitable: Dynamo men must keep one hand in the pocket, or one-armed dynamo-tenders must be given preference. A few days since a dynamo man in Chicago discovered that the field and the frame of his machine were crossed by getting hold of the frame while adjusting the brushes. He has two hands now, which, in their envelopes, are much like boxing gloves, and he will not get either one into his pockets for several days to come.

Promotion.—H. Ward Leonard, of Leonard & Izard, leaves Chicago for New York to become general manager of the United Edison Company. Mr. Leonard will be missed by his many friends here, and he bears with him the best wishes of the entire fraternity throughout the West for his future welfare and success. C. C. H.

Chicago, June 29, 1889.

OUR BOSTON LETTER.

A Western Agency.—The Bernstein Electric Company has established a Western agency, with headquarters at Chicago, and has chosen Mr. George Cutter to look after its interests in that section. Mr. Cutter is well known to the electrical fraternity both east and west, and is admirably fitted to administer the charge entrusted to him. The Bernstein company is rapidly pushing to the front; within the past three months it has materially enlarged its manufacturing plant to enable it to handle its steadily increasing business, and is now prepared to turn out goods in large quantities; it will continue to make a specialty of its well known series incandescent lamps and sockets, and will also enter extensively into the manufacture of incandescent lamps for constant potential circuits, soekets, switches and other fittings.

Annual Meeting of the Quincy Company.—The annual meeting of the Quincy Electric Light and Power Company was held at the power station on Wednesday. The following directors were elected: John Q. Adams, W. G. A. Pattee, John R. Graham, James H. Stetson, John Cashman, William B. White, Abner B. Packard. Horace F. Spear is treasurer, and Walter M. Packard, clerk. The company has earned over six per cent. on the capital invested during the past ten months, and will pay a three per cent. dividend July 1st. It will furnish the Quincy and Boston Railway Company with power for its electric cars.

Car off the Track.—One of the electric cars of the train on the Cambridge line was derailed on Wednesday evening near Hancock street, and caused quite a delay in the operation of the line. The derailment was probably caused by sand and gravel accidentally thrown upon the track by workmen engaged in laying the new rails. The electrical equipment of the train had nothing whatever to do with the occurrence.

Route of Long Distance Wires.—The long distance telephone line between New York and Boston is to come through Taunton with 100 wires, said to be the heaviest trunk line ever built in the country. The poles will be 50 feet high through the country and from 75 to 80 feet high in the cities. The line will follow the old turnpike from Providence to Westville and then branch off and come via Whittenton, Taunton and the Boston Turnpike through Raynham and Easton to Boston.

Power Circuit for Beverly.—The Robinson-Foster Electric Light and Power Company have asked the selectmen of Beverly for permission to erect poles and maintain the same for the transmission of electricity for furnishing power to those desiring the same. A hearing will be given at Armory Hall, Beverly, Friday evening, July 5th.

Couldn't Stand a Bat.—A correspondent of the Manchester, N.H., *American* tells the following bat story: "A bat flying about an electric light one recent evening got inside the globe, and, getting some part of his anatomy between the carbons, immediately extinguished the light. The electricity likewise immediately extinguished the bat."

A Personal Correction.—Mr. William D. McQuesten, who has been extensively reported in the daily press, with several misspellings of name, as being an expert electrician in the employ of the Thomson-Houston Company, and, as such, giving testimony in regard to induction difficulties at the recent hearings in Lowell in regard to the introduction of the overhead railway systems there, is not with the Thomson-Houston Company, but is electrical expert for the West End Street Railway, which position he is eminently well fitted to fill. Mr. McQuesten was in charge of the electric plant construction of the Allston power station of the West End road, which was put in last fall, and later became regularly connected with the company as its electrician, a position the importance of which is daily becoming greater as the road adopts the electric system on more and more of its lines.

Electric Light for Nantucket.—The Nantucket Electric Light Company has decided to establish a plant. The company has leased the Skating Rink for three years, and will occupy about 50 feet of it at the western end. The system will be the Thomson-Houston and will include arc and incandescent lights, a small dynamo for the former, and a 500-light machine for the latter. By the terms of its franchise, the company is required to give the town an arc light, which will probably be placed over the centre of Main street square, in front of the Post Office. Work is already in progress and this summer's visitors to the quaint old town will find the march of modern improvements has invaded their hitherto inviolate retreat. Mr. P. A. Underwood is at the head of the enterprise.

The Dedham Controversy.—The electric light controversy at Dedham has been finally settled, as after a hearing Saturday, the selectmen awarded the franchise to the Dedham Electric Company. Its opponent in the case was the Dedham and Hyde Park Gas and Electric Company. The Thomson-Houston system will be used.

T. W. S.

Boston, July 1, 1889.

Mr. A. A. Knudson, of Brooklyn, is superintendent of the summer carnival electrical exhibition, which is to open at St. John's, N. B., on July 22, to celebrate the opening of the Canadian Pacific Railway to St. Johns. Mr. Knudson is an electrical expert with executive ability, and his appointment is a good one.

We are in receipt of the *Paradise of the Pacific*, published by Messrs. Williams and Wray Taylor in far off Honolulu, Hawaiian Islands. It is carefully edited and gotten up in a way that would do credit to the effete East, and if all the more commendable as being an example of what can be done in the distant Pacific, Honolulu is a pushing place as also instanced in its model electric light and telephone plants.

A pamphlet, illustrating the wonderful growth and present advantages of the City of Kearney, Neb., has been received from the Western Engineering Company of that city, of which Mr. George W. Frank is president, and Mr. J. G. White, general manager. The company is among the foremost of those engaged in pushing the electrical business in this region of the great West.

The St. Louis Exposition management is getting things into shape for the fall entertainment. The following gentlemen have been selected as the electrical committee to have charge of the immense electrical display that is to be given: Ellis Wainwright, Dwight Tredway, L. D. Kingsland, Samuel M. Kennard, David J. Harris, Mr. Harris being chairman. Mr. Fred. W. Whipple has been chosen general manager, and we predict for its management success beyond anything heretofore realized by them. They could not have secured a better man for manager than Mr. Whipple.

Few persons except specialists in electrical science are aware how rapid is the march of electric power over the world. Unused and disused water is everywhere going into the yoke of the dynamo. Mountain streams in Switzerland that have never before been used for any purpose except that of gratifying sight-seers are now supplying power to mills five miles distant, and the manufactures of that country are having a great revival. The latest project of this kind in our own country, and one of the most promising, is that of utilizing the power of the "Dalles of the St. Louis," a few miles west of Duluth. These consist of a series of cascades some miles in length, over which the whole volume of the river precipitates itself, with a total fall of more than 500 feet. A local engineer proposes with a single dam on the St. Louis to run all the street cars in Duluth, to furnish all the electric lights needed, and to supply a large amount of power for other uses. There is room on the river for 30 or 40 such dams. It is the common observation of the electrical journals that all the manufactories of dynamos are running night and day and cannot keep up with their orders.—*New York Post.*

The Electric Club Headquarters in Paris.

The following is from the London edition of the New York *Herald*, of June 17th:

The Electric Club, of New York, has established a headquarters at the Paris Exposition, near the exhibit of the telephone company, where, in addition to other conveniences, they have an attendant conversant with trains and routes in and around Paris, as well as a knowledge of hotels. This course was taken because such a large number of the members of the club were in Europe this year.

Mr. Charles W. Price, of New York, the secretary of the club, while in London on Saturday, extended the privileges of these headquarters to the members of the American Engineering Societies who will visit Paris.

The Western Union Pays Its First Privilege Tax Under the New Law.

The Western Union Telegraph Company has paid its privilege tax for the year ending April 8, 1890, amounting to $3,000, to the State comptroller at Nashville, Tenn. This is the first privilege tax paid by this company since the decision of the United States Supreme Court in the case of the telegraph company vs. the Port of Mobile, in which it was decided that no tax could be collected off an officer of the company. The last Legislature imposed a tax of $3,000 upon the company for receiving one or more messages at any one point in the State and transmitting the same to another point in this State and wholly within the State and not sent in the service of the United States Government. Under this new law the Western Union Company has paid the tax assessed against it. The Tennessee & Ohio Telegraph Company, which controls a few miles of wire, has also paid its tax.

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* * The electric roads in Birmingham, and Ansonia, Conn., are being extended.

* * Work has progressed rapidly on the Eighth street line of the electric road, at Erie, Pa.

* * It seems to be the general feeling in St. Louis that electricity will soon become the motive power on the Broadway line.

* * The Erie Telephone Company made a net gain in subscribers during the months of May and June of 167, and now have connected 11,482.

* * Very successful trial trips are reported of the Weems electro-automatic transit system in Baltimore, Md., where a two-mile experimental track has been built.

* * The Louisville, Ky., *Commercial* prints an able editorial on the advantages which would accrue from a utilization of the city's immense water power for the generation of electricity.

* * The Pleasant Valley Street Railway Company, of Pittsburgh, Pa., has closed a contract with the Sprague Electric Railway and Motor Company for 25 new and novel cars with complete station equipment. The iron poles and the overhead wirework will have the latest improvements.

* * The charter for the Bristol, Conn., and Plainville Tramway Co. was passed by the Legislature last week. The people of this vicinity are enthusiastic over the passage of the bill and steps will be taken forthwith for the building of the electric railroad that will connect Bristol, Forestville and Plainville.

* * Articles of association for the formation of the Wakefield, Mass., and Stoneham Street Railway Company have been drawn, and the company will soon be organized under the general laws of the Commonwealth. The capital stock is $10,000, all of which has been taken in shares of $100 each. Electricity will be the motive power for the road.

* * The residents along South Spruce street, Nashville, Tenn., are greatly in favor of the proposed extension of the electric railway system out that thoroughfare. It is understood that the Mount Vernon & McGavock Company are contemplating placing electric cars on two other branches of their system, viz: North Nashvill and Spruce street. Both lines lead to densely inhabited suburbs, to which rapid transit will be a great benefit.

Telephonic News

*** The long distance telephone line has been completed to Keene, N. H.

*** The new test station of the long distance Telephone Company, in New Haven, Conn., is about completed.

*** The telephone and telegraph companies of Louisville, Ky., are complaining of the disturbing effect of the electric railway wires.

*** The City Council of Hutchinson, Kan., has granted R. R. Price a franchise for telephone, electric light and gas works for 25 years.

*** The citizens of Akron, O., complain of poor telephone service there, which they claim could be easily remedied by the expenditure of sufficient money.

*** The Edison Electric Lighting Company, the local fire department and the Southern Massachusetts Telephone Company were recently granted pole locations by the New Bedford, Mass., board of public works.

*** A conference has been held in Kansas City between Mr. J. R. Mulvane, president of the telephone company, and a committee of the Commercial Club, and as a result the recent unpleasantness in that city over telephone rentals has been amicably settled.

*** Work has been begun on the new telephone system for Hastings, Neb. An entire new set of telephones will be introduced, and the cost of the improvements will amount to several thousand dollars. The new improvements are made necessary by the construction of the new line giving Hastings telephonic connection with Crete, Lincoln, Omaha, Plattsmouth and Nebraska City.

*** Some important changes and improvements are to be made in the telephone service between Niagara Falls, N. Y., and Buffalo. The improvements consist of the establishment of metallic circuits, and when this is done the central office will be connected with the long distance line, and anyone so desiring can talk to New York City, Philadelphia, Boston, and all principal intermediate stations.

*** A strong effort and with every evidence of success is being made to build another telephone line from Camden, Ala., to the Mobile and Birmingham R. R. It is proposed to establish offices at Canton, Prairie Bluff and Catherine, the latter point on railroad at Prairie Bluff, connection will be made with the Selma Line, and Rehobotn, Martin's Station, Orrville, etc. At Catherine connection will be made with a proposed line from McKinley, thus connecting Camden with McKinley, Dayton and Uniontown.

*** Alexander Graham Bell, the millionaire inventor of the telephone, is going to enjoy his summer in a novel fashion. A Baltimore boat builder has built for him the most singular looking craft that has ever been put afloat, patterned somewhat after Mr. Noah's historic craft. Mr. Bell calls it a house-boat. It is an immense catamaran, housed over with a charming cottage that contains double parlors, dining room, billiard room and spacious sleeping apartments, besides kitchen, bath-rooms, and servants' quarters. The house is elaborately furnished and fitted up with every comfort and convenience that can be be found in a modern residence. It is propelled by two powerful screws, and in smooth water it is estimated that the boat will attain a speed of 15 miles an hour. It is now being put together in Nova Scotia and will be ready for occupancy by the time Mr. Bell reaches there with his family and guests.

Improvement in Telephone Exchange Plants.

The recent increase of capital granted to the American Bell Telephone Company was asked for to provide for the construction of a magnificent system of metallic circuits, connecting all the large cities of the country.

In order that the full benefit of these trunk lines shall be realized, it is necessary that the various local companies should entirely reconstruct their plants, putting in metallic circuit switchboards and underground conductors, twisted in pairs.

If all of the licensees co-operate with the same ability as that displayed by the Chesapeake & Potomac Telephone Company, the telephone service of the country will soon be on the high road to perfection. This company furnishes a good example of the value of one man power when you have the right man.

Mr. S. M. Bryan, the president and executive officer of this company, has been a close observer of the direction in which telephone improvement is to be attained, and has decided to put his Baltimore exchange on a metallic circuit basis at once.

He has just placed with the Western Electric Company, an order for over 40 miles of 100 conductor metallic circuit Patterson underground cable. This is by far the largest order for telephone cable ever given, amounting to over $150,000

A magnificent new building has been erected and in this will be placed a Western Electric multiple switchboard of most approved pattern. This switchboard will be adapted for the use of both metallic circuit and grounded lines, and when completed will accommodate 6,000 subscribers.

By next fall, every subscriber in Baltimore will be provided with a complete metallic circuit of copper wire. No iron wire will be used, the circuit of each subscriber being made up of hard drawn copper wire from the cable terminal to the instruments.

Baltimore will be the first all metallic circuit exchange in the United States, and we predict that it will be without equal in the world.

A Remedy for Telephone Companies.

The Cambridge, Mass., *Tribune* contains the following:

"A telephone wire is on exhibition at the Cambridge electric light station that does away with all the trouble experienced on the account of the electric cars. The inventor of this wire, Henry Campbell, of Waverly, when requesting permission to string his wire, said that the induction on telephone lines was unnecessary, and he has more than kept his promise to dispel it. Mr. Campbell asked for the worst possible conditions for running his wires, and with that end in view they were strung on the same cross arms with the wires which are used in connection with the electric cars, from Harvard square through Main street to Brookline, to Morss & Whyte's wire works on Franklin street. This wire consists of two strands, one covered with an insulating material, the other, a copper wire with the same covering. Both of these wires are loosely twisted together and at the same time separated by means of a cord, which is so prepared as not to be affected by the weather. During the past month the telephone has been tested by Mayor Gilmore and the majority of the Cambridge Aldermen, and a few members of the Common Council, the Boston police signal corps and members of the senior class of the Institute of Technology, and has never failed to please those who have tried it. Besides the wire, Mr. Campbell has a device that he introduces at one end of the line to still further obviate possible difficulties, so there is no trouble arising from the electric wires."

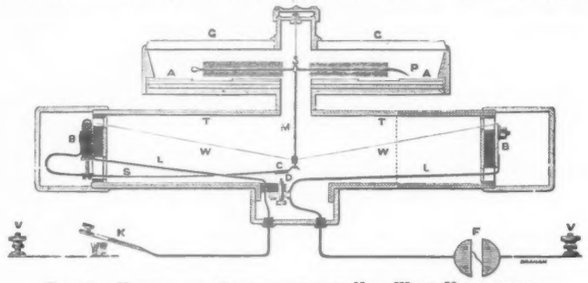
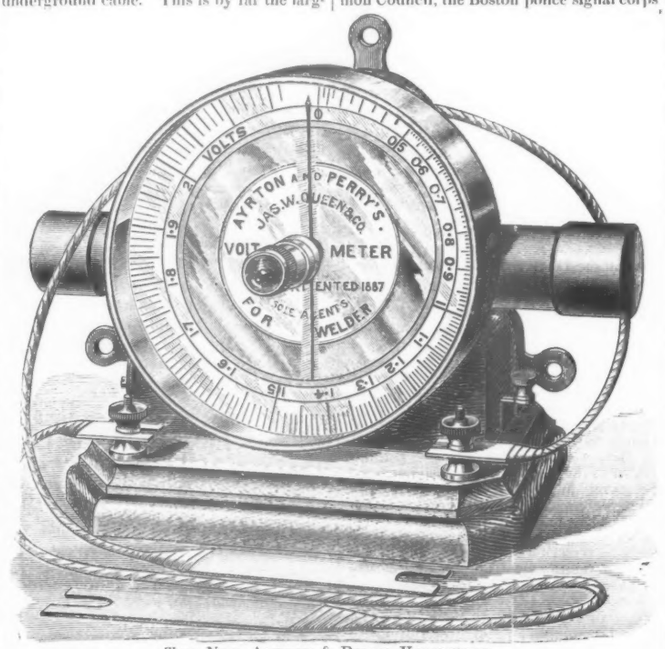


FIG. 2.—HORIZONTAL SECTION OF THE HOT WIRE VOLTMETER.



THE NEW AYRTON & PERRY VOLTMETER.

*** It is reported that a new fire clay conduit is to be laid in Milwaukee, Wis., for the use of the Wisconsin Telephone Company.

*** The Bell Telephone output is reported as follows for month ending June 20:

	1889.	1888.	Inc.	Dec.
Gross output,	6,511	6,636	....	125
Returned,	2,094	1,921	173	
Net,	4,417	4,715	....	298
Since Dec. 21,	1888-89.	1887-88.	Inc.	
Gross,	50,216	29,561	655	
Returned,	11,281	10,876	405	
Net,	18,935	18,685	250	

Ayrton and Perry's Spring Ammeters and Voltmeters and the New Hot Wire Ammeter and Voltmeter.

We are pleased to place before our readers a short description of one of the latest instruments of the well-known electricians, Professors Ayrton & Perry. Quite a full description of the hot wire voltmeter has just appeared in the London electrical journals. Through the kindness of J. W. Queen & Co., agents, we are enabled to give some additional data, which will prove of interest. Amongst other improvements we notice a portable form of spring ammeters and voltmeters. The familiar yellow pine box is replaced by a neat mahogany box with leather strap. This box is part of the instrument, and has the binding posts on its outer side. The lid opens on hinges. The ammeters have a very novel design of showing the direction of the current. Two holes are on the front side of the box, covered with glass; a magnetized disc will place itself in such a way behind the openings in closing the circuit that a white + sign will show nearest to the terminal where the current enters. The calibration of the instrument will be much better than heretofore, since some important changes in winding and adjusting the coils make the deflection of the instrument absolutely proportional to the current.

For the sake of completeness we give a short description of the new hot wire voltmeters and ammeters from the *Electrical Engineer*, London:

Fig. 2 shows a horizontal section of the instrument. In the original instrument the pull of the magnifying spring, *M*, was counterbalanced by the pull of the platinum silver wire, *W W*, attached to the blocks, *B B*; but to save space both these pulls in the present instruments act on the same direction, and are counterbalanced by the flat spring *M*. Hence, as the wire stretches, the magnifying spring, *M*, is stretched, and the pointer, *P P*, to which a number of fine hairs are attached to introduce damping without solid friction, rotates. This flat spring is not only introduced to enable the depth of the instrument to be diminished by twice the sag of the wire, but to permit the introduction of a particular form of fuse. A fuse, *F*, of such a diameter that it would require a far larger current to melt it than would damage the instrument, is employed and, in addition, a platinum tipped screw, *D*, so arranged that when the wire, *W W*, is stretched by any prearranged percentage beyond the amount it stretches for the maximum safe *P.D.* the platinum tip *C*, of the flat spring *S*, comes into contact with the screw *D*, and the working wire is short-circuited. The circuit is then temporarily completed through the lead *L*, to the left, the flat spring, *S*, and the fuse, *F*, when the current increases and the fuse melts without damage to the instrument. With this device it is found that the fuse may be thick, and therefore have but a small resistance compared with that of the working wire, and yet the sudden application of a *P.D.* five or six times as great as the maximum *P.D.* the voltmeter is intended to measure melts the fuse without damaging the wire.

Judging from the ranges of the voltmeter important results are promised, for instance:

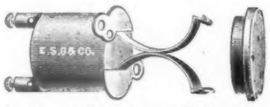
0–2.5 V	graduated to	$\frac{1}{100}$	V.	readable to	$\frac{1}{200}$
0–5	"	"	$\frac{1}{50}$	"	"	$\frac{1}{100}$
0–9	"	"	$\frac{1}{20}$	"	"	$\frac{1}{40}$
0–55	"	"	$\frac{1}{2}$	"	"	$\frac{1}{4}$
0–110	"	"	1	"	"	$\frac{1}{2}$

0–55 volts will be a very desirable instrument for the secondary coil of a transformer for 50 volt alternating currents. Other instruments with two or more ranges should be easily made so that the instrument on account of its smaller compass would have considerable advantage over the old Cardew instrument. The principal of the instrument is such that it may be used for ammeters for direct or alternating current as well; in fact, ammeters are already made to read from 0–1.5 amperes in $\frac{1}{100}$ of an ampere. This instrument would be well adapted for the measurement of direct or alternating current supplied to a single incandescent lamp. Another special feature of the instruments is that they can be placed on a table or shelf, or may be fastened to the wall, since the dial is eight inches in diameter and the divisions are very plain; the instrument will be exceedingly well adapted for station work.

The Glendale Lightning Arrester.

The Glendale lightning arrester, shown in the illustration, is available for almost all situations in which an article of the sort is called for. Heretofore lightning arresters when mounted in groups required to be made to order, and no reasonable provision could be made by which the number could be added to as the number of lines increased, or by which one lightning arrester could be readily withdrawn and replaced by another in case of necessity.

The Glendale arrester is self-contained and not much more complicated than a binding post. It is exceedingly cheap, efficient and small, and consequently a large number of them may be grouped on a small board. Such a board may be mounted on the operating table of the telephone exchange, or on a wallboard in the exchange, or on the switchboard of a telephone office, or at the window, or on housetop fixtures, as convenience may suggest or necessity require. The arrester consists of a cylindrical plug of baked wood an inch long and made to fit an inch hole into which it pushes easily. Two binding posts project from the rear end and a pair of springs at the front of the plug are connected with these binding posts. The springs make contact with each other, but may be opened at the contact point so that a slip of paper may be put between the contacts. This slip of paper forms the lightning ar-



IMPROVED LIGHTNING ARRESTER.

rester, the lightning current sparking through it. Very damaging currents will perforate the paper so freely as to establish metallic connection and thus put on a safety ground. After the storm new papers can be placed and the old papers can be marked and retained as a storm record, showing the number of the line, the date, and the perforations showing the effect. The thinner the paper the more efficient, of course, the arrester will be. Any writing or printing paper will answer, but tissue copying paper will give the best protection. When the lightning arrester is used in this manner, the line is simply connected to one binding post while the other binding post is put to ground.

There are two metallic flanges on the front end of the plug, and wood screws, through these flanges, hold the plug in the board. There are also two holes entirely through the plug. As a result of this arrangement the wire connections may be made at the binding posts at the rear of the board, or they may be made under the heads of attaching screws in the flanges. Furthermore, the holes through the plug permit the wires to be brought up behind the board and connected in front, or to be brought up in front and connected behind the board, as desired.

This arrester may also be used as thermal cut-out on the foil block principle. This is the preferable plan where it is desired to guard cable wires. The high currents are simply caused to melt a weak place in the main circuit and thus leave the line open. When the lightning arrester is thus used the in-line goes to one binding post and the outline to the other binding post. The springs are prolonged into clips, which will grasp a wooden foil block, the contacts of the springs being thus held apart. A piece of gold foil mounted on gummed paper lays along the foil block. The main circuit is thus through the foil and a damaging current will destroy the foil and leave the line open. After the storm new foil paper must be put in, but temporarily the foil block may be removed, allowing the springs to close their contact and complete the circuit. The foil paper can be furnished already mounted, and although very little time is lost in applying the foil a few extra blocks already mounted can be kept on hand if desired.

The firm of E. S. Greeley & Company, New York, are handling the arrester.

Telegraphers' Convention.

The third national convention of the Order of Railway Telegraphers, was held recently at Cleveland, Ohio. The society is a comparatively new one, having been organized at Cedar Rapids, Iowa, June 9th, 1886. At the end of that year they held a convention in Chicago, and there was a delegate representation of 2,500. In 1887 they again held a convention and they had a delegate representation of about 8,000. In June, 1888, the order held a convention at Indianapolis, Ind., and there was a delegate representation of between twelve and fifteen thousand. The order increased from June 20th to September 26th nearly 2,000, and at present numbers about 18,000. Each local division has charge of its own funds, regulates its own affairs, makes its own by-laws, regulates the amount of monthly dues and weekly sick benefits, and is responsible to the grand division only for a per capita tax of 50 cents each on all members in good standing, and an initiatory tax of 50 cents on all members coming into a division after it is organized. The initiation fee is $3,00, invariably in advance, and the monthly dues are what the division makes them and will not exceed 50 cents per month. The order is a railroad operators' organization and is composed of railroad operators only, and is a similar organization to that of the railway conductors. The questions of strikes in the society is severely dealt with, and, futhermore, the grand division officers have been ordered not to affiliate themselves or enter into any agreement with any organization whatever that has strike for a basis. In this it can be seen that the difficulties experienced heretofore between employers and employes are avoided, and harmony not only restored, but retained in the proper place.

The leaders of the order claim that the telegraph fraternity at large to-day is partly composed of a class which tends to demoralize it by immoral practices. The object of the order is to remove all such evil effects and educate and elevate the calling at large to a sense of their responsibilities and calling. It is proposed to abolish the students who enter the ranks of the profession with little or no knowledge of their duties and responsibilities. This does not refer to messenger boys, but to students who go into office to learn telegraphy and nothing else, and who are unable to perform the duties of a railroad operator in all its requirements. A messenger boy when he leaves an office usually leaves it a thorough railroad operator, capable not only of an operator's duty, but that of a station agent, and this because he has thoroughly familiarized himself with all the branches of railroading or of those at his particular station. It is claimed that the reverse is noticeable in the students for the reason that experience is necessary to educate a railroad operator to a sense of the duties and responsibilities imposed upon him.

The constitution and statutes of the order, as adopted and amended, embrace the following principles: No member shall teach the art of telegraphy to any person without permission from the superintendent or chief operator under whom the member is employed, and the consent of the grand chief telegrapher attested to by the grand secretary under the seal of the grand division of the order. Any brother convicted of using his influence for the purpose of creating a strike, is expelled without further notice. The habitual use of intoxicating liquors is a sufficient cause for the rejection of any candidate. An insurance of $1,000 has been adopted and is payable upon the death or total disability of the insured.

The following delegates were reported in attendance: F. E. McCormick, Watertown, N.Y.; A. D. Thurston, Vinton, Ia.; W. A. Bryan, Peoria, Ill.; L. N. Bryan, Dixon, Ia.; E. W. Wayneck, Creston, Ia.; D. F. Ramsay, East St. Louis, Ill.; H. C. Stough, Cold Spring, Col.; R. C. Bonney, Colorado Springs, Col.; P. J. Ward, Brenham, Tex.; D. C. Lacomb, Columbus, O.; T. S North, East Saginaw, Mich.; B. H. Green, Fort Worth, Tex.; W. A. Coomer, South Bay City, Mich.; Charles Tasker, East Saginaw, Mich.; F. H. Collins, West Medford, Mass.; Sam. A. Campbell, Elizabeth, N. J.; T. S. Mulligan, Columbus, O.; W. N. Townsend, Tehula, Miss.; F. A. Cruikshank, Oswego, N. Y.; Ira C. Brown, Buffalo, N. Y.; M. A. Boland, Cincinnati, O.; F. W. Shaeffer, Kent, Ia.; E. J. Norton, Burlington, Ia.; W. C. Russell, Burlington, Ia.; E. N. May, Terre Haute, Ind.; R. J. Stevens, New Cambria, Kan.; J. W. Bledsoe, Terre Haute, Ind.; Charles A. Walker, Chicago, Ill.; Fred. School, Winona, Minn.; Charles F. Williams, Tunnel Hill, Ga.; F. P. Holmes, Washington, D. C.; C. F. Mayer, Claypool, Ind.; P. W. McAllister and wife, Minneapolis, Minn.; J. B. Hoye, Lorain, O.; H. H. Weatherspoon, Fall River, Kan.; George S. Wallace, Richmond, Va.; Curt L. Hinkle, Dubuque, Ia.; James B. Finnan, Baltimore, Md.; J. D. Huddlestone, Roanoke, Va.; A. J. Applegate, Wichita, Kan.; A. J. Hall, Cleveland; J. C. Langley, Dallas, Tex.; W. G. Knittle, Galveston, Tex.; G. C. Flegel, Argos, Ind.; G. M. Bingham, St. Joseph, Mo.; George M. Cotton, Detroit, Mich.; J. A. Gardner, St. Paul, Minn.; John O. Goss, Jr., Omaha, Neb.; J. L. Clark, Waukesha, Wis.; J. E. Morris and wife, Chicago, Ill.; J. E. McLaughlin, Oakdale, Ga.; D. O. Freeman, Omaha, Neb.; A. W. Meader, Toledo, O.; J. C. Harriman, Toledo, O.; Fred. M. Moore and wife, Denver, Col.; J. J. Kearne, Columbus, Tex.; H. W. Thomas, Garrett, Ind.; W. H. Crimmel, Fostoria, Ind.; F. J. Bradley, Pittsburgh, Pa.; A. M. Teeple, Sandyville, O.; R. A. Wyatt, Powder Springs, Ga.; J. E. Mooney, Chicago, Ill.; J. E. Rice, Milwaukee; H. J. Wagen, Mankato, Minn.; W. N. Day, Ute, Ia.; J. N. Bissell, Galveston, Tex.; A. S. Page, Huntington, W. Va.; J. W. Braam, Grand Rapids, Mich.; J. T. Donovan, Grand Rapids, Mich.; P. Conners, Corsicana, Tex.; F. T. Roche, Chicago, Ill.; C. C. Lewis, Boykins, Va.; W. L. Ward, Dallas, Tex.; J. A. Jordan, Pocatillo, I. T.; Miss M. E. Dunwoodie, Detroit; W. A. Thomas, Garrette, Mich.; J. H. Flanagan, Omaha, Neb.; A. Johnson, New Albany, Ind.; J. T. Conners, Albany, N. Y.; E. S. Tobey, Vinton, Ia.; J. T. Royser, Kansas City, Mo.; H. S. Lambdin, Columbus, O.; Joseph Dull, Jacksonville, Fla.; C. W. Maxwell, Jacksonville, Fla.; A. J. Hickman, Texarkana, Tex., J. A. Kelly, Cleveland, O.; F. P. Marshall, Newark, N. J.; W. G. Sprague, Salem, O.; J. E. Mattern, Orrville, O.; F. E. Smith, Woodstock, Neb.; P. W. McAllister, Minneapolis; W. B. Mitchell, Kelleen, Tex.; C. W. Houstin, Cedar Rapids, Ia.; R. S. Nellis, Detroit; A. Johnson, Louisville, Ky.; S. O. Fox, Vinton, Ia.; Fred. M. Moore, Denver, Col.; T. C. Eddy, Cleveland, O.; E. E. Barnes, Eagle Ridge, N. Y.; W. T. Doran, Cedar Rapids; J. J. McElrath, Cedar Rapids; C. B. Snody, Whitehall, N. Y.; C. B. Hanley, Chicago, Ill.; J. Weatherlee, Denver, Col.; W. R. Blackmund, Philadelphia, Pa.

A Telegraph Pole Tax Suit.

In the suit of the city of St. Louis against the Western Union Telegraph Company, brought to recover $22,635 pole taxes, Judge Thayer recently rendered an important opinion. This suit was brought by the city under amended ordinance 11,604, the original papers being filed in the City Circuit Court, and in September, 1888, it was transferred to the United States Circuit Court, where it has since been pending. The decision of the court is important as throwing judicial light upon the vexed question of the telegraph and telephone pole nuisance, and the rights of the city therein. Judge Thayer holds that the city has the right to determine and regulate the location and placing of the poles, but it has no authority to impose a tax on these poles, section 6901, Revised Statutes of Missouri, denying that authority to municipalities. The State may tax the property of telegraph companies, real and personal, in such manner as the Legislature may prescribe consistently with the laws of the State. This the State has provided for through the board of equalization, thereby withdrawing the taxing power vested in the city. Taking Judge Wallace's ruling in the Southern District of New York, Judge Thayer thought it probable the city could require the telegraph company to carry its wires underground, though he avoided any decided expression of his own upon the point, because the section of the ordinance on which this suit was based did not comprehend this point.

⁂ A company is being formed at Lincolton, Ga., for the purpose of building a telephone line to Washington. A large part of the necessary stock has been taken, and a permanent organization will be effected in a few days. Work will commence at once.

TELEGRAPHIC

.... Chinese Commissioners have been examining Chicago's police and fire alarm system, and it is said that it will not be long before steam fire engines, patrol wagons, and electric fire and police alarms are put in operation in Chinese cities.

.... Mr. E. H. Hogshead, manager of the Western Union Telegraph at Meridian, Miss., is in Washington looking after the patent rights of a new system of train telegraph. The method is unlike the induction system, using a primary current.

.... It is understood that the Dominion Government intend making a test case, by bringing an action against the Great North-Western Telegraph Company in Hamilton, Ont., for violating the provisions of the Post-office Acts by delivering letters.

.... E. L. Randall, a telegraph operator, sued the Chicago and Rock Island Company for $25,000 damages for putting his name on a "discharged list." The case came up in Kansas City last week, and the Circuit Court non-suited the plaintiff on the ground that a "discharged list" was a privileged communication.

.... The Kansas City division of the Order of Railway Telegraphers have elected the following officers for the ensuing year: R. W. Jenkins, chief telegrapher; F. S. Irwin, assistant chief telegrapher; A. L. Logan, senior telegrapher; J. F. Roper, junior telegrapher; Dr. P. C. Palmer, past chief telegrapher; A. A. Stone, secretary and treasurer; W. E. Miller, inside sentinel; W. T. Casey, outside sentinel.

.... According to the Butte, Mont., *Inter-Mountain* the Western Union Telegraph Company in that city is prepared to furnish business firms, corporations, public and private institutions and individuals with daily observatory time signals by telegraphic transmission over direct circuits, and to furnish, put up and keep in repair self-winding synchronized clocks, regulated daily by such time signals and the necessary wire connections for such clocks.

.... Last week Mr. Flanery of Memphis, Tenn., took a bunch of messages off his hook and started sending. The first sent was timed 1.21 P. M. After sending them he received two, the last of which was timed 1.36 P. M. Counting them over he found there were sixteen messages in all, or more than one a minute, and this done without any special effort. Mr. Flanery is over sixty years old, and this shows him able to give points to some of his younger brother operators.

.... The Montreal Telegraph Co., has received $31,250 from the Great Northwestern Telegraph Company as a part payment on account of the quarterly payment due. This is without prejudice to the rights of the former under the agreement of August, 1881. The balance, $10,000, is on deposit in the names of Messrs. G. Hague and A. M. Crombie, drawing interest pending the final judgment of the Superior Court. The distribution of the above payment to the Montreal shareholders will be made in a few days.

.... On the 8th of April, 1888, Katy Brown, five years old, was hurt at Promontory, Box Elder county, Utah, having her finger broken in a railway turntable. A telegram was sent to Ogden for a doctor to come on the next train, which was to leave about three hours after the telegram was received. The message was not delivered until the following day, because it was received after office hours, and when the child received surgical attention the next day, her finger had to be amputated. Suit was brought against the Western Union Telegraph Company, and the jury awarded the child $2,100 damages. The supreme court approved this verdict.

* * A new street railway will be built between Wakefield and Stoneham, Mass., and electricity stands a good chance of being adopted to run it.

* * The corner stone of the first building for the Williams Engine Works was laid at Beloit, Wis., on Friday. The structure will be 88 by 145 feet in extent, and is located about 100 yards west of the plant of the Eclipse Wind Engine Company.

* * Chancellor DeWitt, of Chattanooga, has dissolved the injunction obtained by the Telephone Company against the Electric Railway Company, and rendered an elaborate decision on the relative rights of the two corporations. The Electric Railroad Company has begun running cars, everything having been gotten in readiness some time ago, awaiting the decision of the court.

* * The Fitchburg Steam Engine Company, of Fitchburg, Mass., are furnishing the complete power plant for the North Adams electric railway. The engines used will be one single engine and one tandem compound 12 and 22x30. The Gardner Electric Light Company, Gardner, Mass., have an equipment of Fitchburg engines, and are now increasing their plant by the addition of a Fitchburg cross compound 12 and 22x24.

* * The route for the new storage battery electric railway from Peabody square to Salem Willows, Mass., as finally decided upon, is from the square, through Mill, Wallace, and Tremont streets in Peabody, through the new street over the Poor estate to Balcomb street in Salem, thence through Balcomb, School, Mason, North, Federal, Washington, Front (until the new street over South River is built), Charter and Derby streets to the Willows.

* * The executive officers of the Watervliet Turnpike and Railroad Company, Tuesday, signed a contract with Barry & Co., railroad contractors, for the Thomson-Houston system of electric motors. A plant by which the cars on the Broadway line will be run, will be erected at once. Work will be pushed with all possible speed and it is thought the electric motor will take the place of horses on at least one of Albany's street railways within 60 days.

* * The tract of territory in Hamtramck township through which the new Detroit, Norris & Mount Olivet electric railway will pass has long felt the necessity for communication with Detroit. This property has increased in value during the past week at least 25 per cent. At Norris the property owners are jubilant, and talk of holding a jollification meeting. There is hardly any doubt that within two years time the road will be lined with suburban residences and stores.

* * The new street railroad between Salem and Peabody, Mass., has received a vigorous boom by organization of the company, to be known as the Essex Electric Street Railway Company. The capital stock is $50,000, and the following are the officers: Directors, Joseph N. Peterson, William D. Dennis, David N. Cook, P. J. McCusker, Frank E. Farnham, J. Howard Fallon and Clarence J. Messer, all of Salem; clerk, William F. M. Collins; treasurer, William D. Dennis.

* * Under the headline "Exit Mule," the New Orleans *Item* says that a movement is under way in that city which will eventually revolutionize the street car system. The Electric Traction and Manufacturing Company propose to introduce electric cars. The system will be first put into operation on the Crescent City Railroad. The following is the board of directors of the new company: Messrs. W. J. Behan, M. J. Hart, T. Prudhomme, Philip Thompson, J. A. Walker, Adolph Meyer, and J. B. Sinnott.

Address of Welcome to Visiting Engineers.

The reception accorded the American engineers in the United Kingdom of Great Britain by The Institution of Civil Engineers was most flattering. The following is the address of welcome by Sir John Coode, president, delivered on their arrival:

To the Presidents of the American Societies of Civil, Mining, Mechanical and Electrical Engineers:

We, the president, vice-presidents, council and members of The Institution of Civil Engineers, acting on this occasion both for ourselves and the various bodies of engineers of the United Kingdom, hereby tender to you, as representatives of the members of the several engineering societies of America, a sincere and cordial welcome to this country, and gladly avail ourselves of the opportunity of publicly acknowledging, and as far as possible reciprocating, the manifold courtesies which for many years past have been lavished on British engineers visiting the great republic.

It is a source of peculiar satisfaction to receive you within this building, because we are here in the home of the parent of all the duly constituted engineering societies of this kingdom.

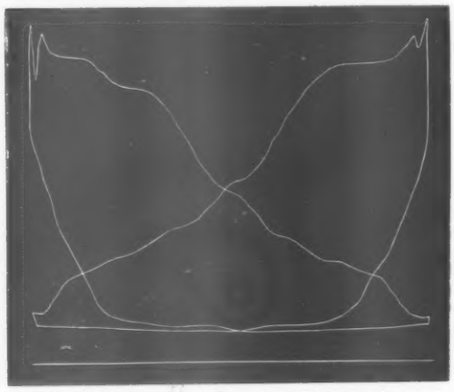
The association of engineers in England into one body, for their common advantage, originated with Smeaton, one of the fathers of the profession; it was not, however, until 25 years after his death, viz, in 1817—wellnigh three-quarters of a century ago—that the present institution was actually formed.

Telford became its president in 1820, and in 1828 it received the Royal Charter, under which it has ever since flourished. In regard to magnitude, it is sufficient to state that our institution now comprises (including the class of students) upwards of 5,700 members, and is largely adding to its numbers every year.

Although the Civil Engineers act as hosts in your reception, the several Engineering bodies of the country are associated with us; and others outside our profession join in the welcome, and have rendered valuable aid in our endeavors to secure your comfort and gratification.

Foremost of all must be mentioned the special permission, given by Her Most Gracious Majesty the Queen, for you to visit and inspect her Royal Palaces and Domains, at Windsor and in the Metropolis. Nor must we omit to place on record the very exceptional and gratifying fact that the Lord Mayor, Aldermen and Common Council of the City of London have been pleased to place at the disposal of the Reception Committee the use of their ancient and noble Guildhall, in order that we may entertain you, in accordance with old English custom, at a festival dinner therein.

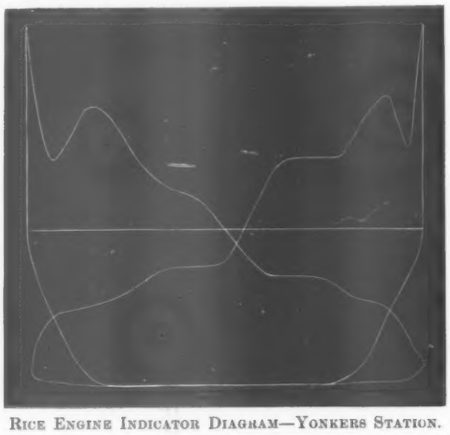
The leading railway, dock, gas and water companies have vied with each other in exercising hospitality, nor have private individuals been lacking in the earnest desire to add to your gratification whilst in our midst.



RICE ENGINE INDICATOR DIAGRAM - YONKERS STATION.

It would be superfluous and presumptuous to enlarge on the professional merits of American engineers. Their great works and clever inventions have passed far beyond the sphere of mere technical appreciation, and have become of world-wide celebrity. We feel justified in regarding the influence of you and your predecessors as one of the principal factors which have raised, with unexampled rapidity, the modest republic of George Washington to one of the foremost nations on earth.

The problem of dealing with great difficulties presented by nature, and, until recently, with comparatively limited means and limited appliances, has been solved by the American engineer, and the solution has left its mark upon the character of the nation.



RICE ENGINE INDICATOR DIAGRAM—YONKERS STATION.

With a population about double our own, and a territory stretching between ocean and ocean, more than 3,000 miles from east to west, not to speak of its extent from north to south, distances have been conquered by your vast system of railways on a scale of magnitude of which we have no experience.

We trust that all the arrangements made for your visits to some of the most important public works in this kingdom will be successful and acceptable, and we hope you may carry back pleasant recollections of your visit to this. SIR JNO. COODE, *President.*

* * Some of the rich summer residents of Newport, R. I., are objecting to the construction of the electric street railway there on the ground of interference with their pleasure drives. The question naturally arises if the poorer classes should not also have facilities for getting about and enjoying an outing.

A Model Small Electric Light Plant.

Next to efficiency, the greatest desideratum in electric light stations is economy—economy of space, fuel, power and wearing parts. But economy is not so easily attainable in establishments of small size as in large ones, as every practical electrician and engineer will admit. It will therefore interest many, we believe, to read the illustrated description of a plant which is in operation at Yonkers, N. Y., and which though small and subject to considerable variations in the time for burning and closing the lamps, is regarded as a model of of economy in each of the particulars mentioned above.

The power plant consists of two Rice Automatic Engines, to each of which are attached two arc dynamos and one alternating dynamo, of the Thomson-Houston pattern; and these are so arranged that a third engine, with dynamos, can be added when it shall become necessary.

The Rice engines are a conspicuous and important feature of the Yonkers station. They were built by the John T. Noye Manufacturing Company, of Buffalo, N. Y., under the personal supervision of Mr. P. B. Rice, the well-known engineer, who has been associated with that company for a number of years. They are of the tandem compound condensing type, with 6 x 16 high pressure and 16 x 16 low pressure cylinders. The speed is 240 revolutions per minute, and the boiler pressure from 60 to 100 pounds.

Some remarkably good indicator diagrams were taken from the engines last spring, a pair of which we publish herewith for the examination of the critical. They will make their own appeal to the practiced eye of the engineer, their excellence being such as at once to draw his attention. They were taken with a large-sized Thompson indicator, using a 40-spring, and at a time when the load consisted of 70 1,200 candle-power arc lamps and 250 incandescents. The coal used is of good quality, and the economy in fuel is particularly noteworthy.

The general plan of the station is also deserving of notice. Engine, condenser and boiler feed pump, are arranged within a rectangle of the smallest possible size. A close coil heater is placed between the low-pressure cylinder and the condenser, which ensures high temperature of the feed-water before it passes to the boilers. The engines are run over so that the bottom side of every belt is the tight side, thus reducing the chances of slipping belts. To save in floor space, the dynamos are stepped, one back of the other. The whole is arranged to secure economy in space with easy accessibility of every working part.

The success of the Yonkers station demonstrates the fact that no electric light plant is too small to pay by its economical operation the increased first cost involved in getting the best possible machinery, and shows that the type of engine there in use has a great future in connection with the production of electric light.

Canadian Business.

The Notre Dame church authorities, Montreal, who have decided to light the vast building by electricity, will use the arc and incandescent lights of the Royal Electric Company. They are to put in two Babcock and Wilcox boilers and a pair of high speed engines, and will themselves run the plant, hoping to make the church the most magnificently lighted building in Canada. Mr. Corriveau has also secured for his company the lighting by arc light of the Canal at St. Johns, Que., which might be followed later by the Lachine canal, if the importance of the latter compares at all with that of St. Johns.

* * The Rapid Transit Company of Newark, N. J., is obtaining new consents for its road in Central avenue, those now granted being for other than a cable road. The directors have not formally decided upon the motive power to be used, but like others they have been impressed with the success of the better class of electric roads.

An Interesting Collection.

In the office of the Narragansett Electric Company at Providence, R. I., there is an interesting exhibit of the Westinghouse alternating current lamps. Upon a shelf at one side of the room are arranged lamps from 10 to 150 candle-power, the 100 and 150 candle-power lamps having double filaments. These lamps, as well as the electrolier in the private office, take their current through an alternating current meter of the Shallenberger patent, which measures the electricity used exactly as a gas meter records the gas burned, and the record is kept in four dials suitably connected by train of gears. In this meter a shaft is rotated at a speed proportional to the square of the current. This is offset to a simple proportion by a fan wheel and a certain speed of revolution counts off the ampere-hours regularly. With only the 10 candle-power lamp aglow the fans barely move, even the imperceptible currents of air in a closed room being sufficient to check the motion for a time when the case is taken off the meter. With 400 or 500 candle-power of lights running, the fans fly so fast as to be hardly discernable. Mr. Perry is having a glass case made for the meter so that its workings may be plainly observed at any time.

—— It is reported that Dr. Joseph B. De Lery, who promoted the Wenstrom Southern Electric Manufacturing Company, of Baltimore, has been elected president of the Wenstrom Northern Electric Company of New York City.

—— A second electric light company has been organized in Pottsville, Pa., the Edison Illuminating Power Company, with a capital of $6,000. The Pottsville Electric Light and Power Company has just closed a contract with the Westinghouse Company to put in a plant for electric lighting.

—— There was a meeting at Boston, Tuesday, of the syndicate recently formed to purchase the foreign electric welding patents. Messrs Henry D. Hyde, W. A. Boland of Boston, and C. I. Lewis of New York were appointed a committee to promote the organization of the company.

—— The New England Weston Electric Light Company have received the following contracts in the past week or 10 days for United States Electric Light isolated plants: Lowell Mfg. Company, Lowell, Mass., 600 lights; Pacific Mills, Lawrence, 600 lights; H. A. Hale, East Arlington, Vt., 250 lights for a factory and adjacent residence.

Opening of Marlborough Electric Railway.

On June 18th, the Marlborough, Mass., Electric Railway, installed by the Sprague Electric Railway and Motor Company, of New York, was put into operation. This road is equipped with the improved Sprague electric railway motors, and has already carried a very large number of passengers.

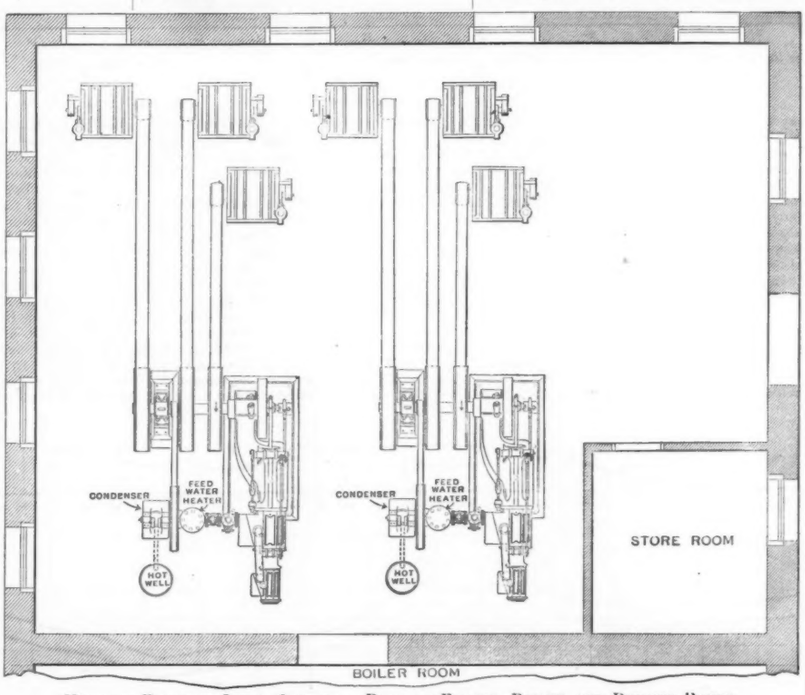
On the first day of its operation, the cars on this line carried 1,400 people, on the second day nearly 2,000, and on the third day a still greater number, making more than a quarter of the entire population of the town during the three days operation. At present, half of these cars tow trail cars, in order to increase their capacity, and the cars are so crowded, that the management of the Marlborough Company, has ordered an additional number of ordinary open cars, so that all the motor cars can draw an ordinary car behind them.

—— C. E. Dustin, of the Schuyler Electric Light Company, with Mrs. Dustin, has sailed for Europe. Their objective point is the Paris Exposition.

—— The following are the newly elected officers of the Lyons, N. Y., Electric Light Company: President, Samuel Scott; vice-president, J. W. Dunwell; secretary, J. W. Van Etten; treasurer, W. N. Deady. Directors, the president, vice-president, secretary, treasurer, L. L. Phillips, Jacob Rodnbach, Daniel Moran, J. W. Putnam, L. M. Blakely.

—— Mr. C. W. Phipps, of the Brush Electric Lighting Company, the chief of construction who has been putting in the new Bangor plant, has finished his work and left for home. The Bangor *Commercial* says of him: "The general opinion formed here concerning Mr. Phipps is that he is a hustler of the most approved sort. He has made a host of friends, among the staunchest of whom are Mayor Bragg and members of the city council."

—— Mr. E. R. Whitney, the electrician and inventor, and his family left St. Johnsbury, Vt., Tuesday for Manchester, N. H., which will henceforth be their permanent residence. Mr. Whitney and his brother-in-law Dr. Hoyt have recently taken out patents for a long distance electric light machine, which they will manufacture at Manchester; but it is understood that their enterprise will not be in opposition to the Standard Electric Company, in which Mr. Whitney is still interested.



YONKERS ELECTRIC LIGHT STATION. PLAN OF ENGINE, BOILER AND DYNAMO ROOMS.

—— The directors of the Annapolis Electric Light Company held a meeting in Baltimore recently and signed a contract to light Annapolis city by electricity for two years from the 1st of July for $3,500. The company supplies lamps and repairs. The reports from the contractors in charge of the work stated that the plant would be ready on the night of June 30 to turn the electric light on the ancient city.

—— The regular monthly meeting of the St. Johns, N. B., Gas and Electric Light Company was held recently. A resolution was unanimously carried expressing regret at Mr. Robert Blair's retirement from the position of president and manager, and placing on record their appreciation of the services he rendered the company during the past 15 years. On nomination of Hon. John Boyd, seconded by Mr. Chas. Patton, Dr. M. Sheffield was chosen president of the board and Mr. Geo. R. Ellis was reappointed secretary-treasurer.

Telephones vs. Electric Roads.

In view of the widespread controversies on the subject, the decision of Chancellor W. H. DeWitt at Chattanooga, in the case of the East Tennessee Telephone Company *vs.* the Chattanooga Electric Street Railway Company, has been looked for with much interest by telephone and electric railway officials. The injunction which had been obtained by the telephone company was dissolved, but only upon the ground that the affidavits showed that the railway was constructed in such a way that it would not interfere with the telephones in point of fact. The opinion has been rendered, and shows that the railway company has no right to interfere with the telephones, and that they can be enjoined where there is a material interference in fact.

—— The Westerly, R. I., Gas Company is furnishing the town with 25 arc and 132 incandescent lights. A new Westinghouse compound engine and 700-light Westinghouse alternating dynamo have been put in.

—— The Schuyler Company has begun the extension of its electric light lines in Alexandria, Va. The plans of the machinery at the gas house for engine, dynamos, etc., are laid out, and work on them will be begun immediately.

An Agent Missing.

A. C. Green, agent for the Jenney Electric Light Company, of Indianapolis, who has made Fayetteville, Tenn., his headquarters for the past year, left there about 10 days ago with, it was supposed, a considerable sum of money on his person to come home. The last heard from him was at Nashville, on the 13th ult., where he told the clerk of his hotel that instead of continuing his journey North he would have to return to South Pittsburgh. It was at that place he had collected about $2,700 for the company which had just completed an electric light plant for the town. Mr. Green, after collecting the money, paid out to Brainard Rorison, secretary of the company, about $1,100 on accounts. He then, with a note for $1,200 and $1,600 in cash, started home with the currency, as has been his custom on similar missions. It is Mr. Rorison's opinion that Mr. Green is either very sick at some out-of-the-way place or has been foully dealt with by some one who expected to find on his person a large amount of money. He has been with the company for four years, and his accounts have invariably been found correct.

ELECTRIC LIGHT NEWS

—— The town of Canton, Mass., has just appropriated $3,000 a year for electric lights of the Westinghouse system.

—— Postmaster D. Ward Northrop has been re-elected president and James P. Stow secretary and general manager of the Middletown, Conn., Electric Light Company.

—— Mr. Fred. W. Bradley, of Lowell, Mass., a recent graduate of the Mass. Institute of Technology, has accepted a position in the New York office of the Edison company.

—— Last week the Thomson-Houston Company had orders, outside this country, from City of Mexico, Copenhagen, Denmark; Tunis, Africa; San Jose, Guatemala, and Osaka, Japan.

—— The Edison Company shipped a train load of 24 cars of electric machinery last week from Schenectady, N. Y., for Buenos Ayres. The machinery went by special train to New York.

—— During the past few months a new electric light company has put up a plant in Houston, Tex., and now two companies are illuminating the city and furnishing motive power for various uses.

—— The Brooklyn (N. Y.) Electric Light and Power Company have petitioned the aldermen for the privilege of competing in the ex-city of churches for both public and private electric lighting.

—— The City Council of Visalia, Cal., has granted a franchise to the Incandescent Electric Light Company. Five hundred lights are already taken. The plant will be in operation July 15.

—— The municipal officers, of Belfast, Me., voted to grant the Easton Electric Company, of New York, permission to erect poles, etc., if operations were begun on or before the first day of August next.

—— Superintendent Whittier, of the electric light company, Auburn, N. Y., was arrested Saturday, on charge of interfering with the fire alarm wires. He promised to avoid interference in the future and the complaint was withdrawn.

—— Madison, Dakota, has assumed metropolitan airs with one of the finest electric light plants in the Territory. The capacity of the plant is 30 arc and 650 incandescent lights, and the city starts out with 20 arc and 450 incandescent lights in use.

—— The electric lighting of the city of Manchester, N. H., has been completed and 240 lights of 2,000 candle power each are in operation. The Manchester Electric Light Company's plant, which furnishes these lights, cost upwards of $160,000.

—— The city of Brainerd, Dakota, voted in a special election on the proposition to give a bonus of its electric light system to a syndicate which is arranging to develop the water power there. The vote was almost unanimous for the donation, standing 926 for disposal to 15 against.

—— The East End Electric Light Company, of Pittsburg, Pa., has now completed an arc light addition to its plant. The company has two Babcock & Wilcox boilers of 1,000 horse-power each, put into the building, and the structure is, throughout, made of brick and iron. The only thing of wood in the whole building is the switch-board.

—— The Essex County Electric Company of Orange, N. J., is laying a foundation for a new 100-horse power Ball engine, to be used as an adjunct of the present plant. A new 200-horse power boiler and one or possibly two more 45-lamp dynamos are also to be put in preparatory to the company going into the incandescent light business next Fall.

Monthly Meeting of the American Institute of Electrical Engineers, New York.

The 36th meeting of the Institute was held in the lecture room of Prof. R. Ogden Doremus, at the College of the City of New York, at 8 P. M., June 25th, 1889. The following paper was read by Mr. Leo Daft:

Some Recent Electrical Work on the Elevated Roads, and its Bearing on the Rapid Transit Problem.

It is particularly noticeable that all who have so far considered the question of rapid transit for the city of New York, have assumed that it is so deficient in these facilities that the question was of the most vital importance, and while I do not for a moment wish to underestimate the urgency of the demand to meet the rapid growth which has already almost overtaxed the elevated system, we should not lose sight of the fact that New York has, even to-day, all things considered, a better rapid transit system than any other city in the world. In evidence of this, it is only necessary to cite the facts that one may enter a well-appointed car at the Battery, and traveling through the best atmosphere of the city, be carried with remarkable smoothness to 59th street in 26 minutes, or at the average speed of 12 miles an hour, including stops, and, in about this manner, the elevated system contrives to carry one half million passengers per diem for a lower rate of fare than is done in any other city for similar accommodation, and with a smaller proportion of accidents than may be found on any steam road in the world making an equal number of stops per 100 miles run. On a recent holiday, namely, April 30th last, 835,721 passengers were carried on this much abused system without noticeable detention or accident—but New York wants more, and in view of the rapidly growing traffic which has already almost exceeded the ability of the system, it must be admitted that the demand is a pressing one, as this one half million will grow to one million in a short time, and it is exceedingly improbable that any steam motor can be devised to permit of this increase, at least on the present structures, without subjecting them to quickly destructive strains. With steam, therefore, the only avenue open for increasing the passenger capacity, namely, the use of longer trains, is obviously out of the question, since it is a notorious fact that the present motors are taxed to their utmost.

To the mind of the mechanical engineer, having in view the ordinary co-efficients of tractive ability, there is no remedy for this, but I think I shall be able to produce at least some little evidence that owing to certain effects which have not yet been satisfactorily explained, an electric motor may be made capable of solving the problem, at least so far as the ultimate strength of the present elevated structure will permit, inasmuch as the effects alluded to certainly do increase the tractive ability beyond that obtained by the use of any co-efficients which

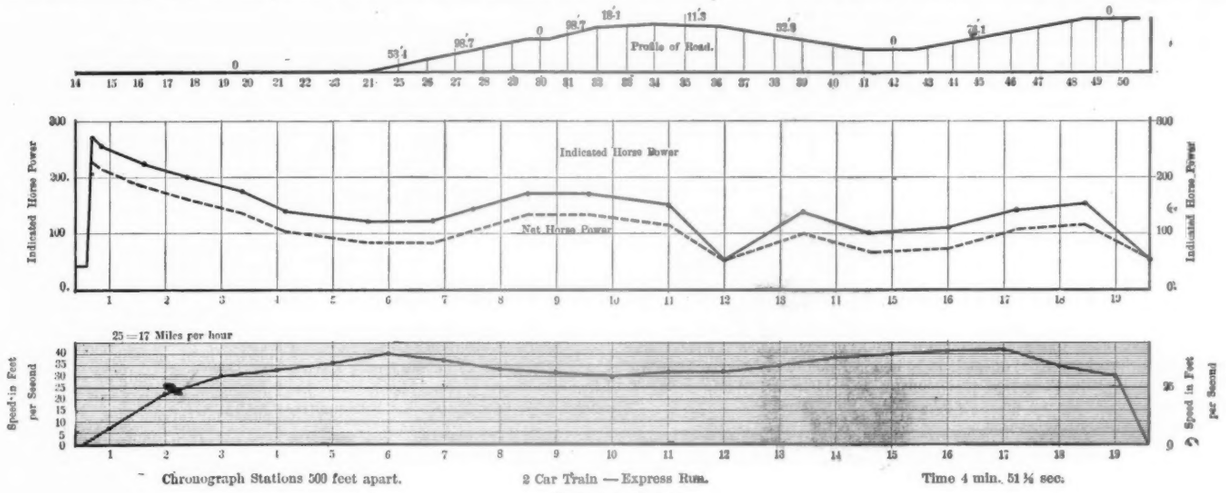

Profile of Road.
Indicated Horse Power
Net Horse Power
25 = 17 Miles per hour
Speed in Feet per Second
Chronograph Stations 500 feet apart.
2 Car Train — Express Run.
Time 4 min. 51¼ sec.

Diagram No. 1.

When this final gradient was reached, however, the ascension was less easy and certain, though it was accomplished several times; but an attempt to exceed it resulting in failure, this was regarded as the maximum under those circumstances.

Now, let us for a moment consider what this actually indicated: A motor having a total weight of 600 lbs. will have a rolling resistance certainly equal to 10 lbs. per ton, making 2.25 lbs. for this item; at 54.9 per cent. the grade resistance will be 329.4, making a total of 331.65 lbs., or 55.27 per cent. of the total weight, considerably more than double the ultimate working limit of adhesion under the most favorable condition cited by Wellington in the work already quoted, but as these conditions, namely, a perfectly dry rail, with drivers absolutely free from any lubricant, are so rarely found in practice as to be scarcely worth taking into account in every day work, it may fairly be considered as equal to three times the ultimate effort usually developed before slipping occurs.

A prominent engineer in dismissing the idea of increased traction due to the passage of a current between the adhesive surfaces, falls into the error of assuming that the effect would be precisely the reverse of that which has been observed, and in support of his argument cites the case of the lessened friction between the metallic points and the cylinder of chalk noted in a well-known instrument. I need hardly, however, call the attention of this audience to the entire absence of any proper analogy between these two cases. That the motor should not have ascended this gradient I am well aware—indeed, out of the commonest respect for such authorities as Messrs. Clark and Wellington, it ought to have stopped at the bottom of the gradient, meekly rotating its wheels, but I was confronted by the indisputable fact that it did go up, and did it every day with perfect regularity for a number of days before many gentlemen, among whom were mechanical engineers, who could not account for that state of things at all—and, frankly, neither could I, but as a cold fact it outweighed all the arguments in the universe. In illustration of my own doubts on the subject, I may mention a little instance that occurred at that time: I had written to a mechanical engineer of my acquaintance stating the facts, and received in reply such an astonishing array of diagrams and mathematical proofs that this could not be done, that I actually went out into the yard and had the motor perform the feat several times before I felt strong enough to write my friend, in a half apologetic way, acknowledging the soundness of his views, but being compelled to reiterate the statement that the thing was being done just as I stated.

But, seriously speaking, the significance of this test can scarcely be overestimated, showing, as it undoubtedly did, the possibilities of working under conditions which have been hitherto considered impracticable.

Now, I do not for a moment pretend to assert that either dyna mic or static adhesion may be increased to this extent by a large locomotive under the conditions of ordinary practice, as I am fully aware from subsequent experiments that the observed effect in this instance was due to a very large current of low potential passing through the very small contact areas presented by wheels only one foot in diameter impinging upon a light 16 pound rail; the effect is, however, undoubtedly obtainable to the extent of at least 30 per cent. under the ordinary conditions of railroad practice, since I have observed it many times with a dynamometer by causing the current to pass from wheel to rail in one series of measurements, and through a cable connected with the motor in another series, and in this way results as high as 85 per cent. increase have been many times noted. In addition to this it is more than probable that the tractive efficiency of electric locomotives is higher than that of ordinary steam locomotives for mechanical reasons.

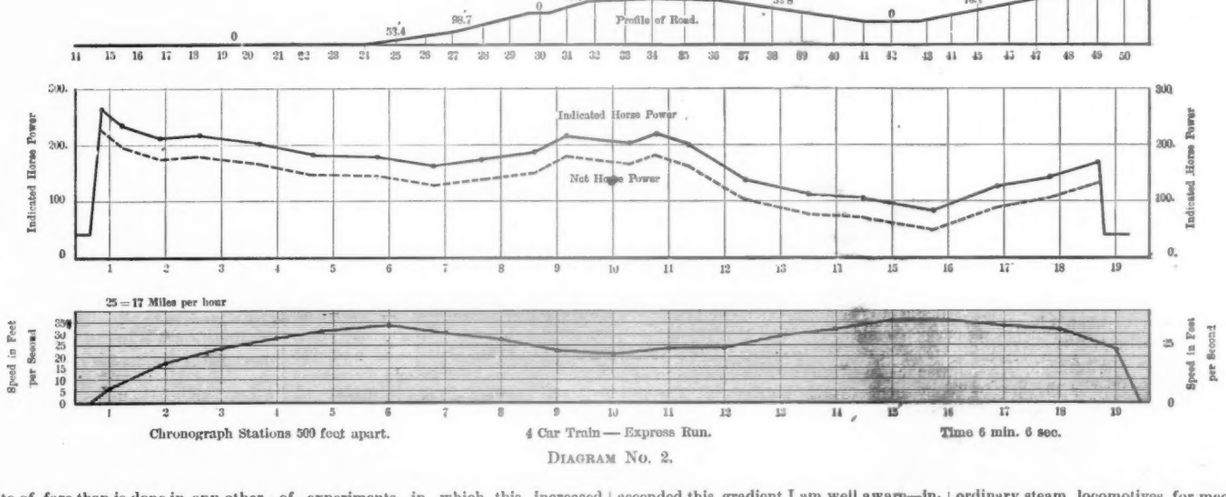

Profile of Road.
Indicated Horse Power
Net Horse Power
25 = 17 Miles per hour
Speed in Feet per Second
Chronograph Stations 500 feet apart.
4 Car Train — Express Run.
Time 6 min. 6 sec.

Diagram No. 2.

Referring to the plan of multiple motors where it was proposed to use one or two machines on each car, while there can be no question that the advantages are theoretically very marked in some directions, I think the multiplication of motive parts, necessarily much smaller and more liable to disarrangement than those on one machine of equivalent power, together with enormously increased first cost, and cost of attendance and repairs, present practical drawbacks from which any railroad manager would naturally shrink; and, notwithstanding the able manner in which this plan has been presented and its obvious theoretical

of experiments in which this increased tractive capacity was observed and carried to its apparent maximum.

During a series of experiments with small motors, made at the works of the Daft Company at Greenville, N. J., in the year above quoted, I constructed an adjustable incline upon which a small motor was caused to ascend with a gradually increasing gradient until the extraordinary angle of 2,900 feet per mile, or 54.9 per cent. was reached. Up to this point the motor, weighing 450 lbs. plus one man weighing 150 lbs., total 600 lbs., was readily started from a position of absolute rest at the bottom, and ascended the gradient, being occasionally stopped midway and started again with perfect ease.

solution of a much vexed problem, I do not see any reason for changing my original plan; on the contrary, exhaustive experiments recently conducted lead me to the conclusion that the problem may be readily solved in another way.

Lest any misunderstanding should exist as to the object of this series of tests, permit me here to remind you that this motor was not expected to solve the problem by towing longer trains at higher speeds than are at present attained. It was simply for the purpose of proving that a machine weighing a little more than one-half the present motors would equal, or nearly equal, their performance in that respect, and, while it must be admitted that in the matter of acceleration on the heavier gradients the steam-motors still show somewhat greater ability, the result of the tests indisputably proves that, with motors of the same weight as those now employed, at least six car trains on the Ninth avenue and seven to eight car trains on the Sixth avenue, may be propelled at a considerably higher average speed than at present, and when the absence of reciprocating parts is taken into account the advantage on the side of the electric motor, in lessening the destructive strain on the structure, will form an important factor in the economy of operation. That the absence of this destructive strain is no idle dream of the mechanical engineer has been fully realized by many competent observers of the electric trains, since it has been a subject of general remark that the noise of the electric train is merely that inseparable from the rolling of the wheels over the track, the motor itself making no more noise than one of the cars in tow.

I refer to these points particularly because so many disappointments have been experienced by the public who seem to expect the electrical genii to wave his magic wand over the earth and cause all mechanical difficulties heretofore experienced to vanish in a moment, hence it is pleasant to be able to refer to the actual accomplishment of some of the most desirable advances in municipal rapid transit.

But the principal object is to show without fear or favor that it is now possible to run and compete with steam on the Ninth Avenue Railroad, and, of course, any of the others with a certain concrete economy based upon a series of tests, made under circumstances to the last degree prejudicial for an economical showing, and without taking into account the great gains which would inevitably result from the use of a large central station, with dynamos of the highest efficiency, and with the obvious advantage resulting from the operation of a number of motive units under varying loads from a central station or dwelling upon such abstract economies as freedom from cinders, dropping water, smoke and noise.

Before proceeding to a review of the actual accomplishment, allow me to briefly describe the motive machine in question. The motor, named "Ben Franklin," consists of a frame having two driving wheels coupled by discs outside of the bearings with two cast-steel cut split gears mounted on the back axle and an electric motor pivoted on pedestals at the rear of the cab and supported on similar pedestals with a screw adjustment for raising the whole machine to remove the armature, and wrought-steel pinions in nearly vertical engagement with the gears.

It is evident that a considerable degree of resilience is not permissible with such an arrangement, but a sufficient amount to prevent excessive hardness in working is obtained by placing alternating plates of rubber and iron in the pedestals above and below the bearings. A similar arrangement at the driver-bearings cushions the machine without interfering with the mesh to an appreciable degree, in fact what little wear has so far been observed between pinions and gears shows remarkable uniformity of engagement.

Before the motor was placed in the cab it was deemed advisable to make a few Prony brake tests of its ultimate ability. It was therefore placed in the central station at Fifteenth street, and a series of tests made resulting in the development of 128 horse power. A few higher readings than this were apparently taken, but as some little doubt was felt as to the accuracy of the observations, those were rejected and the above accepted as the ultimate reading.

The piece of track upon which the experiments have been conducted, is eminently adapted for testing the tractive ability of a motor for this purpose, since there is only one piece of level track, 2,200 feet in length, the rest, embracing a distance of 1.846 miles, consisting of gradients varying between 11.3 and 98.7 feet per mile, and in one instance, namely, at 30th street, the start is made only a few feet from the bottom of a 98.7 foot gradient, thus testing the tractive capacity of the motor to the utmost.

On October last experiments with this machine were begun on this piece of track, which, through the courtesy of Col. Hain, was placed at my disposal from nine o'clock at night until four o'clock the next morning, and the first experiment consisted in taking a light load of one or two cars over the road to test the conductor and switch connections. This train was gradually increased night after night, until one of eight Ninth avenue cars, each weighing 12 tons, was towed over the entire road, going up to the 98.7 foot grade at a speed of 7½ miles per hour, and making the entire distance in 7', 35", or an average speed of 14.6 miles per hour. Although a drizzling rain prevailed, and the rails were slippery, there was an entire absence of slipping.

I regret that at the time of this experiment we were not using the dynamometer, but taking the ordinary co-efficient of rolling friction for a light train of this kind, namely, .004, and assuming the grade resistance to be at the same rate per cent. of the total weight of the train as the rate per cent. of the grade, and the rate per cent of the grade being 1.86, we get the following:

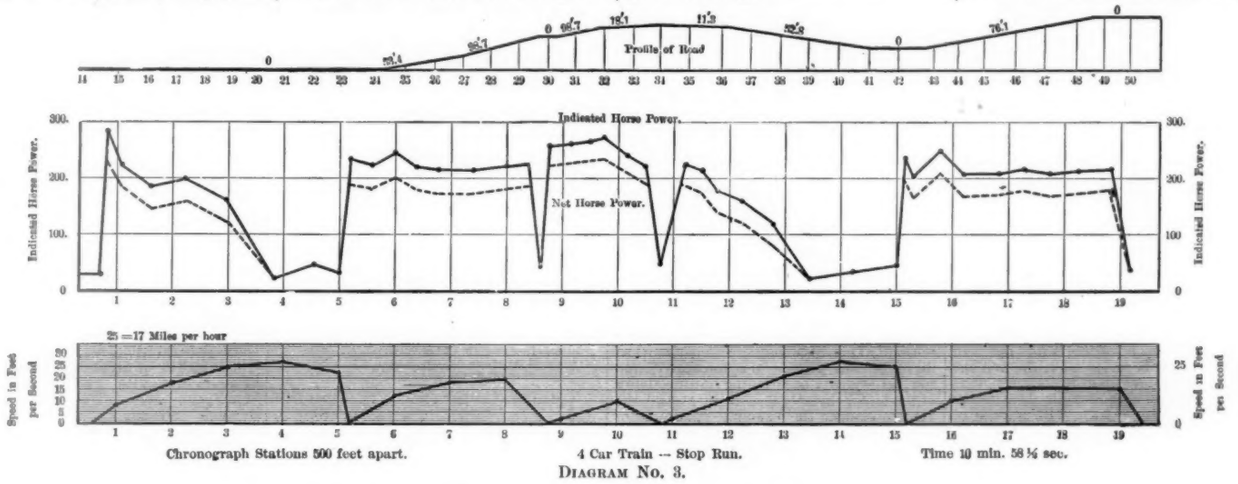

Profile of Road
Indicated Horse Power.
Net Horse Power.
Indicated Horse Power.
Indicated Horse Power.
25 = 17 Miles per hour
Speed in Feet per Second
Speed in Feet per Second
Chronograph Stations 500 feet apart.
4 Car Train -- Stop Run.
Time 10 min. 58 ½ sec.

DIAGRAM No. 3.

$$\frac{1.86\times4781\times660}{33000}=$$

95.8 horse power, to which should be added at least 15 per cent. for friction, and a so-called "head resistance" of the motor equalling 14.37 or a total of 110.17 horse power at 15th street.

The maximum velocity attained by that train on the level in passing 23d street was 24 feet per second, or 16.36 miles per hour.

These tests were continued for several weeks, at intervals of two or three nights, during which time a great number of experiments were tried as to the ability of the motor to make the switches, start on gradients, etc. And I am able to state, as a simple matter of record, that though the tests were of the most exacting character, absolutely the only repairs or delay during all this time and subsequent tests were two, one when a spool had to be removed from developing a contact, which caused a delay of one night, and the other time when a moving axle wore a hole through the insulation of an end spool, and caused a detention of 15 minutes. With these two exceptions, the motor has been ready to run at any moment during the whole time in spite of the roughest treatment, and being left on the track exposed to the weather for months past.

I think I am entitled to say that these results, which were of course carefully watched by the Manhattan railway officials, led to our obtaining permission to run in the day-time between steam trains—a permission which, you may be sure, would not have been granted on a road which has a world-wide reputation for its almost military discipline and precision of management, if the motor had not earned the right to some confidence. On the 28th day of January, 1889, we began running between the hours of 11 and 2 in the day-time, which was continued with a three-car, and occasionally four-car train, running express until the 12th day of February, when we were requested to take a train of flat cars, loaded with iron to the weight of an average four-car train with 75 to 100 passengers, in lieu of the light trains formerly employed. With this train, weighing in all 70 tons, I made several trips over the road between the ordinary steam trains, but finding the brakes hardly trustworthy enough for such critical work, with trains only three minutes from us on either side, it was decided to discontinue this service, and a four-car Sixth avenue train was substituted. With this train several trips were made, but in consequence of the absence of air-brakes, it was not considered advisable to proceed with the ordinary "stop run," and the remainder of the work was done at night, but I may say that during this period of 30 days, with one exception above noted, not the slightest detention was caused to the regular trains, as we were always able to switch on to the track, make our trip, and get back on to the switch at 50th street without interfering with the steam trains in the least.

A number of experiments made about this time show that the mean speed with a three-car empty train, running express, on the up-town track, was about 23 miles per hour, though on the level, the ability of the motor with a similar train, is nearly 28 miles per hour. This is by no means the limit of speed which the motor is capable of attaining, for, as will be seen by reference to diagram No. 1, the work of acceleration was still in progress when the gradient at 24th street was encountered, hence it seems perfectly fair to assume that, even with that 40 ton train, the maximum level speed is not shown. With a lighter load the speed would undoubtedly be much greater, but for prudential reasons it was not deemed well to push this matter of speed to its extreme limit, especially in view of the fact that the machine was not designed for a speed of over 25 miles per hour, and any derangement resulting from excessive peripheral armature speed might have been prevented by ability to present a clean record to-night.

In order to measure the speed with sufficient accuracy for practical purposes, I divided the track into 19 sections of 500 feet, each section being provided with a thin copper plate attached to the guard rail at the side of the track, and connected with a copper rod or insulated side of the conductive system. This plate was made as short as possible to insure a complete contact without

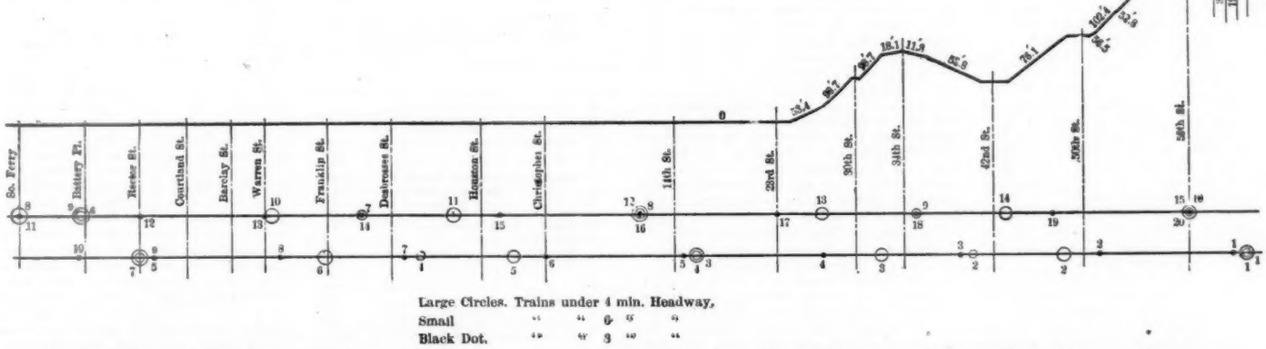


DIAGRAM No. 4.—SHOWING THE EFFECT ON THE HORSE POWER REQUIRED, DUE TO LOCATION OF GRADES, WITH TRAINS UNDER VARIOUS HEADWAYS.

occupying an appreciable interval. A copper brush, attached to the motor in such a manner as to travel on the top of the guard rail, was connected with one terminal of a chronograph of the well-known type, which we made for this purpose, consisting of a paper-covered cylinder rotated at a uniform speed by clockwork, and a stylus actuated by an electro-magnet so as to penetrate the paper at every closure of circuit. This instrument was carefully tested, and the results verified by experiments before the readings were accepted. The indicator cards were taken at the central station by Mr. Idell and his assistants, after a careful comparison of watches so as to insure synchronism in observing the effects of acceleration and gradients. The dynamometer used was a very fine specimen of the liquid type owned by the Manhattan Railway and made by Mr. Shaw, of Philadelphia, and after careful calibration by Mr. Shaw and Mr. Idell, was found to be accurate within an appreciable amount. The dynamometric readings I have omitted from these observations, for the reason that they were found to throw so much light upon the ordinarily accepted co-efficients of train resistance, under many of the conditions which the text books have not yet considered, and especially the formulas relating to the subject of acceleration, that time would not permit a thorough digest of the results, hence it was deemed better to leave this part of the subject for later consideration, and I trust you will shortly hear from Mr. Idell on this subject in his usually able and thorough manner.

Referring to the diagram No. 1, representing the run of a two-car express train having a total weight of 40 tons, it will be seen that the initial indicator card is exceedingly high as compared with the apparent effort required. The reason for this is that our plan in taking the cards was to make the first one at the instant of closing the circuit, thus giving a card due to the simple dead resistance of the motor, which, with a ratio of peripheral velocities necessary for this work and a speed of 30 miles per hour, would necessarily be low, and occupy at least a few seconds in developing an economic working resistance, unless a complicated arrangement was resorted to. But this point will be later referred to.

Following the speed line it will be seen as might be expected, since we see that the accelerative effort is rapidly diminishing towards the foot of the gradient, that the indicator cards become a minimum at the maximum velocity of the train, but quickly rise beyond 27th street, where the gradient is 98.7 feet per mile. The effect, however, of acquired momentum is here very evident, since neither the indicator cards nor the declining velocity are at all proportional to the resistance imposed by the gradient, and the speed of the train varies but little from this point to 46th street, being only slightly increased on the down grade between 34th and 42d streets, due to a change in the combination for the purpose of checking what would otherwise have been too great speed for safety. The dips in the indicator line between 36th and 37th streets is occasioned by the cards having been taken at the instant of the change in combination; at 46th street the decrease of speed is the result of encountering the gradient, 76.1 feet per mile, and between 48th and 49th streets, the circuit was opened for the stop at 50th street, when, as will be seen, the indicator line quickly drops to the friction card only. This run of 1.846 miles was made in four minutes and 51½ seconds, as recorded by the chronograph. This is at the mean speed of 22.84 per hour, with a maximum of 28.4 miles per hour indicated on the up grade between 44th and 46th streets. The speed in passing 23d street, the end of the level stretch, was 28 miles per hour.

The mean power exerted at the central station for propulsion during the trip was 103 horse-power, which will compare not unfavorably with steam practice.

Turning to diagram No. 2, representing a four-car express train having a total weight of 70 tons or about the average weight of a four-car loaded Ninth avenue train, we are confronted with the curious fact that the initial indicator card is lower than that shown with the two-car train, but a careful examination of the two diagrams will show that the card was taken a few seconds after the start and not, as in the case of the two-car train, at the instant of closing the circuit. The effect, therefore, of the rapid development of working resistance is very clearly shown, and is a most important factor in considering the high initial cards, since they are only of an instant's duration and hence comparatively unimportant in their effect upon the total power required to run a considerable number of trains at one time. In this run the characteristics of the two-car run are very nearly reproduced, though it is particularly noticeable that the indicator line does not show so large an increase as one might, at first thought, expect from doubling a number of cars, but this is accounted for by the greater ratio which the friction and load of the motor presents to the two-car train.

The total time of the trip with this train consisting of four Sixth avenue cars, each weighing 15 tons, plus the motor weighing 10 tons, was six minutes and six seconds with a mean speed of 18.15 miles per hour and with a maximum speed of 25.24 miles per hour between 42d and 43d streets, which is, however, almost equal between 24th and 25th streets when, as above noted, acceleration was still in progress. The mean power exerted at the central station on this run was 129.3 resulting from 91 ordinate readings. This result is almost exactly the same as the running time of the express steam trains of equal weights over the same distance, and may be repeated at any time.

Comparing the two former with diagram No. 3, representing a four-car "stop run," several of which were made chiefly for the purpose of demonstrating the ability of so light a motor to stop at the foot of a gradient of 98.7 feet per mile, as at 30th street, with a train of 70 tons; and ascend the gradient from a position of absolute rest with ease. These "stop runs" with this train were made without encountering any difficulty whatever, and at no time during the whole tests has the motors shown indications of overload. That the four-car "stop runs" were not made in schedule time will be seen by the diagram, but a careful inspection of the same will show the exceedingly prejudicial effect of the absence of an efficient brake system, compelling the opening of the circuit two or three blocks before the station is reached in order to insure a proper stop at the platform. This is graphically shown on the indicator line of the diagram where the circuit is seen to be open at 19th street for the stop at 23d, thus considerably lowering the speed, and of course stopping the rapid acceleration shown on the speed line at the third chronograph station. This disadvantage was so marked that I do not present the four-car "stop run" as evidence of anything but the ability of the motor heavily loaded to ascend the gradients under the exacting conditions of an exceedingly difficult piece of track.

That there is not a marked difference between the 10 ton motor and the 18 ton locomotive in the initial effort on the level may be seen by comparing a run observed by a Manhattan Railroad official on March 9th last, with a steam motor and three-car train with 75 passengers or a total of about 57½ tons; we see that while the steam motor required one minute and 39 seconds to make the distance from 14th to 23d streets, the electric motor in diagram No. 3 accomplished the trip with a train weighing 14 tons more in one minute and fifty seconds, or only 11 seconds added for the increased 14 tons. Surely not a discouraging exhibit when the fact that while the absence of powerful brakes compelled the opening of the circuit at 19th street, the throttle of the steam motor was probably open up to 22d street, although on this point I have no direct evidence—but that is the usual practice.

Before dismissing this diagram, I will again remark that while the mean speed was not equal to the ordinary schedule of the Ninth avenue road, it is nearly equal to that of the Third avenue with 22 ton motors and 80 ton trains. In considering the apparent mean expenditure of power at the central station it should be borne in mind that the effort exerted by these motors on such rapidly varying gradients, and over such short distances on the elevated railroads, are not by any means represented by the ordinary co-efficients of train resistance and effect of gravity, as it has been before pointed out very clearly by others that, while the grades always exert their full effect, the advantage generally obtained from down grades on long runs by acquired momentum is here nearly always lost by the position of the gradients with reference to the stops. It has been shown by Messrs. Sinclair and Campbell that on the Third avenue road with the 80 ton trains and 22 ton motors, 170 horse-power is not infrequently exerted, hence to consider this problem merely by the ordinary co-efficients of rolling friction and gravity resistance would and does frequently lead to very serious errors in computing the amount of power actually used, on short railroads, with frequent stops.

However, it is not my purpose to enter into the niceties of train resistance, since the best authorities differ widely on those points, and theoretical economics form no part of the present subject. But as I think I am presenting to you for the first time a critical examination of actual competition with steam motors on steam roads in the work of towing entire trains, I trust you will not fail to recognize that electricity is at last measured and weighed against its most formidable opponent in railway practice.

For many years the electric motor struggled hard to prove its ability to compete with even the most costly competitor, namely, manual labor, and even here the introduction of the dynamo machine was necessary to achieve the victory; then quickly followed the long competitive battle with horses, in which it is evident the equine has been signally defeated, and to wrest a victory from the steam locomotive in its domain is quite another matter, but I think you will agree with me that proof of a large economy in the vital item of fuel under decidely adverse circumstances may be so construed without dangerous optimism, and the results of all these tests has seemed to prove that the measurements might be laid bare without in the least shaking the confidence of competent judges in the ability of the electric motor to replace steam for service, at least as severe as that of the elevated railroad systems; and in amplification of the results obtained, we have here a diagram (No. 4) graphically representing the present service of the Ninth Avenue Elevated Road where the position and number of trains for all hours of the day are plotted and the actual horse-power required, as shown by the indicator cards.

No. 1.

Ten three-car trains to be run under six-minute headway between 59th street and South Ferry.

TRAIN NO.	LOCATION.	H. P. REQUIRED.
10	Starting at 5th street	200
9	Up grade to 34th street	170
8	Running on level	130
7	"	130
6	Starting at Battery Place	190
5	" Rector street	190
4	Running on level	130
3	"	130
2	Down grade to 42d street	
1	On switch at 59th street	
		1,250
	Add 10 per cent. for contingencies.	125
	Total	1,375

Estimated amount of power required to equip, electrically, the 9th avenue division of the Manhattan Elevated Railway, 10 four-car trains to be run under six-minute headway between 59th street and South Ferry.

TRAIN NO.	LOCATION.	H. P. REQUIRED.
10	Starting at 56th street	200
9	Up 52 ft. grade to 34th street	200
8	Running on level	150
7	"	150
6	Starting at Battery Place	200
5	" Rector street	200
4	Running on level	150
3	"	150
2	Down grade (52 ft.) to 42d street	
1	" " into switch 59th street.	
	Total	1,400
	Add 10 per cent. for contingencies	140
	Total	1,540

Fifteen four-car trains to be run under four-minute headway, between 59th street and South Ferry.

Location of trains when train No. 15 has been under way two minutes.

This gives larger results than when train No. 15 is starting from 59th street

TRAIN NO.	LOCATION.	H. P. REQUIRED.
15	Down 105 ft. grade to 50th street	
14	Up 52 ft. grade to 34th street	200
13	Running on level	150
12	Starting at Christopher street	200
11	Running on level	150
10	Starting at Cortlandt street	300
9	" " South Ferry	200
8	" " Battery place	200
7	" " Barclay street	200
6	Running on level	150
5	"	150
4	Up grade from 23d to 30th streets	200
3	Down grade to 42d street	
2	Up 105 ft. grade to 59th street	250
1	On switch	
		2,250
	Add 10 per cent. for contingencies	225
	Total	2,475

Twenty four-car trains to be run under three-minute headway between Fifty-ninth street and South Ferry. Advancing trains one minute from start.

TRAIN NO.	LOCATION.	H. P. REQUIRED.
20	Down grade to 50th street	
19	" " 42d street	
18	" " 30th street	
17	Running on level	150
16	"	150
15	"	150
14	Starting at Franklin street	200
13	" Barclay street	200
12	" Battery Place	200
11	Running on level	150
10	Starting at Rector street	200
9	Running on level	150
8	Starting at Warren street	200
7	Running on level	150
6	"	150
5	"	150
4	Starting at 30th street	220
3	" 42d street	200
2	Up grade to 59th street	250
1	On switch at 59th street	
		2,870
	Add 10 per cent. for contingencies	287
	Total	3,157

RESUME.

And to obtain the average for the day.

Train No.	Cars on Train	Headway.	Time.	Time in Servce	H.P.	H. P. Hours
		MIN.	A.M. A.M.	hr. min		
10	4	6	5.09 to 6.03	0 54	1,540	800
20	4	4	6.03 to 6.15	0 12	3,157	631
21	4	3	6.15 to 7.00	0 45	3,157	2,367
20	4	4	7.00 to 7.24	0 24	3,157	1,315
21	4	3	7.24 to 7.41	0 17	3,157	1,052
20	4	4	7.41 to 9.03	1 22	3,157	4,209
			P.M.			9,900
10	3	6	9.03 to 4.15	7 12	1,375	
			P.M. P.M.			2,735
20	4	4	4.15 to 5.07	0 52	3,157	
22	4	3	5.07 to 5.53	0 46	3,157	2,420
20	4	4	5.53 to 6.13	0 20	3,157	631
10	4	6	6.13 to 9.00	2 47	1,540	2,880
				15h.51m.		29,940

Average h.p. per hour $\frac{29940}{16}$ = 1,871 h.p.
To which must be added the power consumed in engine and dynamo, friction and loss in line.

Station fraction, $\frac{1,871}{300}$

2,171 h.p.

Evap. 7.5 water for 1lb. coal. Hence coal consumption, 2,171 x 16 x 2.3 — 38 + 3 tons for banking, — 41 tons at $2.25 — $92.25 per day.

From this table it will be seen that for five hours out of the 16 of daily service 2,870 horse-power would be required, or, adding 10 per cent. for contingencies, 3,157 horse-power. During these times, when 20 and 21 four-car trains would be in operation under three minutes headway, being reduced to 1,250 horse-power, or, adding 10 per cent. for contingencies, 1,375 horse-power, for the seven hours and 12 minutes intervening between 9.03 A. M. and 4.15 P. M. when 10 trains of three cars are in service under six minutes headway, while during 54 minutes of the early morning, between 5.09 A. M. and 6.03 A. M., and the late evening service of two hours and 47 minutes, between 6.13 P. M. and 9.00 P. M., in which case 10 four-car trains are in service 1,400 horse-power would be required, or, again, adding 10 per cent., 1,540 horse-power.

It should be remarked that the power indicated for this service might be very advantageously divided up into four engines of 800 horse-power each, as an examination of the traffic table will show that for only five hours per diem the whole of them would be required, and during the long period of seven hours and 12 minutes, between 9.03 A. M. and 4.15 P. M., two of the engines would be ample for the service.

The results are, however, plotted, and show that the total horse-power per diem equals 29,940, or divided by 16, the number of hours of service, 1,871 horse-power per hour, and adding 300 horse-power for dynamo and engine friction, the total should be 2,171 horse-power per hour, which at 2.2 lbs. of coal per horse-power per hour equals 38 tons of fuel consumed per diem, and adding three tons for banking the fires, equals 41 tons at $2.25 per net ton, or a total of $92.25 per diem for fuel alone. In this connection I should mention that the coal here referred to is a mixture which may be obtained at the dock in New York for about $1.80 per ton, and which is shown by Barrus in his work entitled "Boiler Tests," to be capable of evaporating seven and a half pounds of water per pound in a properly constructed furnace.

There are several makers of compound engines in this country who will guarantee the performance of their engines on 16 pounds of steam per horse power per hour. It is thus evident that the amount of coal above referred to is a safe one for modern practice on so large a scale. The present locomotives on the Ninth avenue require an average of 40 tons of coal per day for motive power and braking, but experience has shown that it is economical in small locomotive practice to use coal of the best quality, hence the cost of this 40 tons of coal is $200 per day, or more than double the cost of that for the electric motive system.

It is of course necessary to add to the electric estimate a number of charges, such as wages of firemen and engineers at the central station, which would probably bring this item up to about $150 per diem, considering other items balanced by their practical equivalent in the present service and the cost of repairs, depreciation, etc., to be about equal, which is not far from the fact.

It is thus evident that without considering the future obvious advantages which must necessarily accrue from the use of a great central station equipped with dynamos as before stated, and a conductive system ample for all requirements of the road that with the comparatively wasteful central station arrangement we have here considered involving the use of small dynamos of a very old type placed at the extreme end of the conductive system, and suffering from many incidental disadvantages, that it is possible to run the Ninth Avenue Elevated Roads with electric motors at an actual and considerable saving of fuel to-day, and if this is not the only example of such a practical demonstration, as opposed to direct steam propulsion, it is at least the first I have been able to find on record.

The experience of these extended tests and almost innumerable indicator cards, together with countless observations which have been made during the past eight months, have naturally borne fruit in eliminating many objectionable features which only such an examination could develop, and, though, as has been said, it is no part of the object of this paper to treat with other than actually accomplished work, it seems but proper to add that the experience gained in this direction has been embodied in another motor now nearly complete capable of not only doing such work as is at present accomplished, but of solving, at least for the near future, the vexed problem of extended traffic for the elevated railroads,

and, though no actual tests of it have yet been made, there can be little doubt, judging from the performance of the present machine, that it will be capable of towing at least a six-car train on the 9th avenue elevated road with a considerably increased average speed and with a comparatively low initial effort, due to a change in the proportions of parts and manner of winding, to meet the peculiar conditions shown in the diagrams.

In this arrangement the braking of the motor and train has been electrically provided for, also, of course, the lighting, but as this machine is not actually finished, I will not further refer to it other than to call your attention to a part of the proposed plan, namely, the conductor, a section of which has already been placed on to 9th avenue elevated road at the curve below 14th street.

There are also economies of braking and in the manipulation of the train, to which I cannot at present further allude, which would, however, in all probability, considerably reduce the working expenses. In this motor the experience which we have had in handling has led to great simplification of the regulating and reversing gear so that one man may handle the train without the least assistance.

That the plan first suggested by the late Sir William Siemens of braking the trains by converting the motor into a dynamo and so returning a part of the stored up energy of the train to the conductive system, would result in considerable economy, there can be no doubt, provided a thoroughly satisfactory method of practical application were applied, but it is an item that does not appear very conspicuously in any of the quantitative examinations which I have yet seen of any electric system, and while I do not wish to be understood as lightly estimating such an obvious economy before accepting it as so important a factor, as its theoretical consideration by some electricians would indicate, I should like to see at least a few carefully digested observations of actual performance with motors of high power.

In conclusion I trust that if the foregoing facts are not accepted as conclusive proof that the problem is already solved that they may at least furnish sufficient amount of tangible material to assist in early and complete accomplishment of our most sanguine hopes.

DISCUSSION.

The Chairman (Vice-President Francis R. Upton): The question of quick transit in New York city is one which comes pretty close to all of us, and I think that this paper should bring forward a number of speakers. We will be pleased to hear remarks.

Mr. Charles G. Curtis: I would like to ask Mr. Daft if he could estimate the average efficiency of the motor as they have been running it, taking fully into account the results obtained:

Mr. Daft: I have not done that. The object of these tests was to demonstrate that we could run economically in the matter of fuel; and such estimates as we have of its efficiency I am hardly prepared to show tonight. In fact, the experiments have not been entirely concluded; and, as I say, this work was intended simply to demonstrate the concrete and absolute economy in the matter of fuel. It is quite easy to deduce from some of these diagrams a low efficiency in some cases, especially on initial and accelerated effort, but the concrete economy is that which I specially refer to, and that is absolute.

The Chairman: Are there any other questions to be asked or remarks to be made on this subject? It is a subject which is now interesting a great many people—the great advance in electrical engineering, and the possibility of carrying people, both on surface and elevated roads, by means of electricity.

Mr. Curtis: Do you pass the entire current through the tread of the driving wheel of the locomotive, so that the total current is occupied in increasing the traction?

Mr. Daft: Yes.

Mr. Curtis: With regard to the question which Mr. Daft brought out, of how much the calculable total horse-power consumed on the elevated railroads is, I may say that I had a little experience which was rather amusing, because it tends to show how easy it is to make a very great and a very ridiculous error in figuring upon such a problem unless every element is carefully considered. About four years ago, in the winter time, I was very much interested in the subject of running the elevated railroads by electricity, and I had the means of obtaining reliable data as to their speed, coal consumption and everything that was known at the time, and I figured out in the ordinary way what the average horse-power of those locomotives was, for the purpose of getting the average coal consumption. It turned out that the average coal consumption, as I determined it, was about 20 pounds of coal per horse-power hour; and that agreed with a calculation which had been made before, and with the results obtained at that time by electricians concerning the substitution of electricity for steam. When I made that calculation it occurred to me that the element of inertia—the overcoming of the weight or inertia of the train—was a matter that ought to be considered but I put it aside, assuming that it could not amount to a very considerable portion of the whole power. About a month later something brought the subject to my mind again, and upon revising my calculations and allowing for that element, I found it to be three times as much as the entire tractile effort, calculating the maximum speed on trains as given at that time at 23 miles an hour; and taking the weight of the trains at whatever it was, and figuring the energy that must be put into the train to overcome this inertia; dividing that by the total distance travelled in a given time (which I think was about 1,100 feet per minute) it showed that about 58 or 60 horse-power was expended simply in overcoming the inertia of the train. That was in addition to the tractile effort. I went over the figures again very carefully, and I think there were published in the *Electrician* and *Electrical Engineer* where the original figures, which were not more than four or five hundred per cent. wrong, had appeared about two months before. About four or five months later Mr. Campbell wrote me that he was going to make some tests on an elevated railroad locomotive. I did not see the tests, but he sent me the results of them. He found the average horse-power throughout to run between 70 and 80, which was within 10 or 15 per cent. of what I figured it. I do not mention it by way of taking the slightest credit for any accuracy in the calculation, but simply to show how easy it was to figure the whole thing out, and get it right when you gave to every element the weight that it ought to have. The same calculations showed that a great deal of the power, anywhere from 100 to 200 horse-power, was necessary to start the train with the acceleration that they required in order to make schedule time on the elevated railroad. Mr. Campbell's experiments determined the remarkable fact that those locomotives developed a horse-power with about five and a half pounds of coal per hour. These figures were published in the *National Car Builder* at the time, and were so startling that they were denied by a great many civil engineers. I think that the question of whether it is better to have a single locomotive to each train or to make each car its own locomotive is a matter that can be determined only by experiment. Of course, as has been said, there are very strong theoretical advantages in favor of having each car its own locomotive. It dispenses with the main locomotive and the heaviest part of the train under the present steam system, and it enables you to increase the length of the train indefinitely. I understood you to say, Mr. Daft, that your machine was about one-half the weight of the present locomotive

Mr. Daft: It was rather more than one-half of the weight. The machine weighs ten tons, and I believe the locomotives on that road weigh a little over 18 tons. Some of them are a little more than that, but I think that a fair average.

Mr. Curtis: You only use one rate of gearing?

Mr. Daft: Only one.

Mr. Curtis: Have you any friction clutch?

Mr. Daft: Nothing of the kind on the present motor.

Mr. Curtis: May I ask if you know about how the counter-electro-motive force compares with the direct when you are running at full speed?

Mr. Daft: I have not the figures here, to-night, and cannot give you those particulars now. I have particularly confined myself to this question of coal economy, and I propose, if I have the opportunity later, to deal with the other part of the subject.

Mr. Joseph Wetzler: Mr. Daft alluded several times to the effect of the absence of brakes on his train, and also states that in the new train which he is equipping he proposed to introduce proper brakes. I would like to inquire what form those brakes will take, and whether they are direct electric brakes, or those in which electricity is merely used as an auxiliary, the momentum of the train being utilized to create a vacuum, as has already been done.

Mr. Daft: The electricity is an auxiliary, but I am not at liberty to enter into details at present.

Mr. Geo. B. Prescott, Jr: It seems to me that in the question of the transmisson of power to a great distance, the loss of energy in the conductors themselves is a very important factor, and is one that Mr. Daft has not touched upon. I think it would be interesting to know the initial potential that he worked out, and what he would consider the practical potential for a line the length of the elevated road, and also how far apart the generating stations would have to be.

Mr. Daft: I did not propose to enter into that question at all to-night, as that was not a part of this paper. It was simply as I stated repeatedly, to show this concrete economy. I propose later, having an opportunity, to deal with the other part of the subject, and especially when a motor of another type to which I have alluded, is put on the track. But I may say that I have to some extent, on this particular question, discarded the practice I had before adopted, and used a very much higher potential, and that the potential which has been used here is considerably higher than I have made it a practice to use anywhere else, and for many reasons—one of them being that the conductor system is so far out of the reach of the public, on the elevated structure, that it seems hardly possible that any danger can result from it. I have used potentials which are sufficiently high, and of necessary economy, without using a copper mine on the track.

Mr. Curtis: I presume you have not in mind the relation between horse-power and the number of miles to be conveyed; that is, how many horse-power are distributed over a mile.

Mr. Daft: No; I have not.

The Chairman: I notice that Prof. Anthony is here, and we would like to hear from him.

Prof. W. A. Anthony: Mr. President: I came here to listen, I have not had very much to do with electrical traction, and have not very much to say on the subject. I would rather listen to what others are saying; but I would like to ask Mr. Daft if I understood him correctly with regard to the gradient which he has overcome by means of the electro motor. I understood him to say that he has had an electro motor run up a gradient of 45 degrees. Is that so?

Mr. Daft: Yes.

The Chairman: We would like to hear from Mr. Mailloux.

Mr. C. O. Mailloux: I would like to plead very nearly the same excuse that Professor Anthony has, namely, that I came here principally to listen. My experience with electrical traction has not been in that same line, and I have pursued with regard to it what might be called an expectant policy, or maintained what might be called an expectant attitude; for the reason that, while I did not for one moment regard the project of substituting electricity for steam on the elevated roads, or upon a scale of equal magnitude, as an unfeasible or impracticable thing, yet I doubted if the art had advanced sufficiently to enable us to carry out the engineering details of it with sufficient accuracy in order to obtain industrial results that would lead to a successful competition with steam I am very glad to see the progress in that direction, which is now made public in the able paper read by Mr. Daft this evening. I am surprised to see that more advance in that direction has been made than I had anticipated, at the same time I am prepared to say that I still remain somewhat conservative. That while I do not for one moment doubt that success will ultimately be ours, in that field as well as in others, yet we have a great deal of ground to cover before we can relegate the locomotive to the shelves of old and ancient models. I was reading in a Spanish paper recently an article wherein the anticipated substitution of electricity for steam is spoken of in very rhapsodical and enthusiastic terms, and wherein it is said that we should soon see the steam engine entirely done away with and shown to our children as a curiosity. I do not think that is likely to be the case. I think that it will be some time before we have overcome what might be called the inertia of the railroad people—before we have overcome their inborn prejudices. It is only a few days ago that I had a conversation with a person interested in elevated railroad management in some mechanical or technical capacity, and I had occasion to notice what a strong prejudice there is against anything but steam for the purposes of traction in that service. That prejudice is the result not only of a training of perhaps 30 or 40 years upon the part of the individual in the art of applying steam to that particular purpose, either upon elevated or surface roads, but also of the observation of experiments and trials which have been made in various parts of the country, and I might say of the world, and which, not being unqualified successes, have been very eagerly construed by those people as being proof of unqualified failure. In order to overcome this long standing prejudice, therefore, we shall have to be sure, and make assurance doubly sure, that everything is all right before we go ahead, in order to be certain that we can command the way, and meet successfully that which now holds possession of the field—steam—and guide him out of it. I would like to ask Mr. Daft in regard to the difficulties (if I may so term them) of conveying current to the motors where the network of tracks is at all complicated by switches. There are certain parts of the system where there is a considerable number of switches and sidings, where I can conceive that there would necessarily be some difficulty in the conducting of current to the motors, caused by the necessity of carrying a separate conductor outside of the rails, or in any other way.

Mr. Daft: We have not experienced any special difficulties in that direction, although, of course, we have not had entire possession of the track. It has been necessary to leave the track in such condition that the steam motors could operate. But we have, except in one or two instances, much less difficulty by using a contact brush on both sides of the motor, and where the continuity of the conductor was broken on one side we could almost invariably make it good on the other. That is true of almost every switch that we have had to encounter on the system as yet, even at 50th street, where the switching is more than usually complicated, we have so little difficulty that only in one or two instances have we had to bridge a distance of a few feet (I think in one case five or six feet) by momentum.

Prof. Anthony: It has always been my belief that we should at some time reach the solution of this problem of electrical traction on the elevated railroad. Ever since the elevated railroad started, or ever since we began to use electrical motors for traction at all, it has been my belief that we should at some time reach the consummation of that result. The difficulties are not electrical. It is easy enough to build an electrical motor which shall have the power necessary to pull the train. The difficulties, it seems to me, are mechanical and economical. When we take the problem into consideration, the question is not, is it possible to do it, but, is it possible to construct an apparatus cheaply enough, and to make it operate cheaply enough to compete with steam locomotives. That is a question which is not so much an electrical as it is a mechanical one. It seems to me that Mr. Daft is doing a great deal to solve that part of the problem. There are a great many problems that come in here to be studied in connection with it. Mr. Daft has referred to one difficulty—that of braking the trains in these early experiments. Of course, some sort of an electric brake must be devised. It is not going to be easy to put an air brake on an electrical train, although we might perhaps use an electric motor for compressing the air to use with ordinary brakes, but it will be found better to use some electrical system; and such a system must be devised. We must be able to handle the train exactly as we do the steam train. We must be able to make our stops and our starts as quickly, in order that there may be no more lost time than at present, so that the difficulties, as it seems to me, are not in simply constructing the electric motor, but in overcoming the various mechanical difficulties which are to be met with in the problem, and in fact in answering all the requirements of the service. As to the economical question I may perhaps say a word or two. I have had nothing to do with the study of electrical traction, and have never given it very much thought except in looking over the results which have been reached by others. I have on one or two occasions computed the cost of transmitting power over considerable distances with stationary motors, and I have been somewhat surprised at the results. Assuming 2,000 volts as the potential, I have found that, when we came to get up into hundreds of horse-power, the cost of plant becomes something rather enormous: and when the question has arisen of transmitting a water-power over a distances of five or 10 miles it does come out every time that a man could locate a steam engine at the point where he wants the power, and if he could get coal at $4 per ton, run the whole thing at a less cost, taking into account interest and depreciation of plant, than he could by putting an electric motor, dynamo and water-power, for transmitting the power.

Mr. Mailloux: I wish to endorse Prof. Anthony's statement. It was of special interest to me because it was a statement of my own experience. In making my observations with regard to the progress in the art of engineering I should perhaps have said that I put the emphasis on the word *engineering*, and particularly on the mechanical part of it, and that would bring my observation at once in analogy with Prof. Anthony's; because it is particularly on that side of it, and with regard to the production of the manufacturing processes by which the cost of turning out machinery can be reduced, that I have particular reference to. There is no doubt that the cost which the contractor, engineer, or company must provide for, in order to make a profit on each equipment, is somewhat higher, in fact considerably higher than the cost which an equipment by steam or other well-known methods would be under the same circumstances. That is what I meant by progress in the art. I mean the general progress which is the result of evolution, and which has enabled the steam engine manufacturer and the manufacturer of lathes, and other machinery to reduce the cost three or four times in a period of 25 or 30 years, and to simplify and perfect the construction, and to make a smaller weight of metal and a fewer number of parts perform the same functions equally well, and in most instances far better. Those are the general factors of progress in the art which we must look for in order to accomplish the results. Now, in regard to the question of momentum, I think that the point made by Mr. Daft is a very important

one indeed, as is also that made by Mr. Curtis. I can scarcely conceive of any more important factor to deal with in the problem of engineering and in the system of electrical traction, whether on the surface or on the elevated roads, than that of momentum. Because it has such enormous limits bearing on the cost of power under different conditions, the size of car, the number of miles it can be run, and a great many similar results which are so largely dependent upon it. But there is probably no more influential condition than the distance between the stops. As Mr. Daft has shown, on the elevated roads the grades happen to be placed in some instances in such a way that the momentum cannot be utilized; but on surface roads I have seen instances where the momentum of trains could be utilized, and only those who have tried it can get an adequate idea of the amount of energy which is stored in the form of momentum in a moving body. Where the gradient is not too severe the car is sometimes enabled to run for a long distance, and even to come to a comparative stop, and then upon being relieved from the brake pressure go on with a perceptible rate of speed, and in that way a great deal of economy of energy can be exercised. This is particularly true with regard to suburban routes where stops are not so frequent. But in cities where the stations are located very closely all this energy which otherwise might be utilized in propelling the car is necessarily lost, and not only that, but we must provide a means of starting it quickly. That is the secret of braking a car. We extract from it the energy which exists there in the form of momentum. Of course if we could find means of utilizing it at the same time it would be all the better, but I doubt whether it is proper for us to consider that problem at present. It will probably come up later.

The motion of thanks was unanimously adopted and the meeting then adjourned.

* * A franchise has just been granted for an electric road on Fort street, Detroit, Mich.

* * The new railroad from Denver to Edgewater, Col., will be operated by electric power.

* * A company has applied for and will probably receive a 25 years' electric road franchise for Petaluma, Cal.

* * A Davenport, Ia., man is said to be engaged in planning another ice-cutting machine, to be operated by an electric motor.

* * There was a large exhibit of electric railway signals shown at the Saratoga Convention of the Master Car Builders last week.

* * Four St. Paul capitalists have bought up the street railways of Winona, Minn., and will extend them and introduce electric power.

* * A sixteen mile electric road is to be built between Salem, Ill., and Centralia. Dr. S. D. Mercer of Omaha, Neb., is the promoter of the project.

* * It is reported that two floors of the old Colts Armory building in Hartford, Conn., have been rented for the manufacture of the graphophone.

* * Augusta, Ga., believes that recent activity in the stock of the local street railway company means the introduction of electric power at no distant date.

* * The newspaper representatives of Cincinnati were recently given a ride over the new Mt. Auburn electric railway, and describe their impressions enthusiastically.

* * Mr. Colby, superintendent of the Fairfield and Waterville, Me., Horse Railroad, made Skowhegan a flying visit recently. It is stated that he went to look over the ground with a view to the building of an electric railway between there and Norridgewock.

* * The Oswego, N.Y., Fuel and Illuminating Company held a regular meeting Tuesday, in that city, at which all the directors were present. H. D. McCaffrey and James F. Herrick were appointed a committee to secure a location and site for building and plant. W. M. Clark of Albany, John D. Brown of New York and W. A. Poucher, were appointed a committee to draft the by-laws of the company. It is understood that the company has unlimited capital and is ready for active work.

Columbia College School of Mines. Course in Electrical Engineering. Announcement.

A course in Electrical Engineering has been established in the School of Mines in charge of William P. Trowbridge, Professor of Engineering, Francis B. Crocker, Instructor in Electrical Engineering, and Michael Pupin, Assistant Instructor.

The full course for a degree will occupy two years and there is a partial course which can be completed in one year.

The course of instruction will comprise:

Lectures on the principles, phenomena, and applications of electricity; including the dynamo, motor, electric lighting, transmission and distribution of power, land and sub-marine telegraphs, telephones, Electro-metallurgy, &c.

Study and recitation on standard electrical text books.

Examination and explanation of practical electrical machines and models.

Examinations and reports of visits to electrical stations, factories, and plants.

Workshop practice in actual construction of electrical apparatus and machines.

Designing and drawing of electrical machines and apparatus for construction.

Designing, drawing, and preparing specifications for electrical plants; lighting, power distribution and transmission, railway, telegraph, telephone, and electro-metallurgy.

Practical work in setting up and use of instruments for testing; efficiency and constants of electrical machinery; resistance of machines and lines; insulation of machines and lines; location of grounds and faults; photometric tests of lights.

Mathematical relations of electricity to light, heat, magnetism and mechanical energy; mathematical determination of electrical laws, units and constants; mathematical theory of flow and action of alternating currents.

Original investigation and thesis on assigned subject, such as efficiency of motors, storage batteries, etc.

Graduates of the School of Mines, and of other institutions of like grade and standing, will be admitted to the course without examination. An application has been made to the trustees for authority to admit to these classes students who are not graduates of technical schools upon their passing the necessary examinations.

For general information and circulars apply to Registrar of the School of Mines, Columbia College, 49th street, cor. Fourth avenue, New York.

Storage Battery Combination.

Joseph Smith, Esq., director of The Julien Electric Traction Company, Limited, of England, we are informed, has just affected an amalgamation of all the storage battery companies, and the chief electric railway companies of England, under the name of "The Electric Construction Corporation, Limited."

In this amalgamation are included the following companies:

The Julien Electric Company, Limited,

The Electric Power Storage Company, Limited.

The Elwell-Parker Company, Limited.

The Railway Electrical Contractors, Limited.

The Sprague patents for electric traction and transmission of power.

The capital stock of this new company consists of £500,000. Subscriptions were opened on the 4th of June at par, and were closed the same day for double the amount required.

Among the directors are Mr. Pender, Sir Daniel Cooper, Sir Robert Fowler, Sir Douglas Fox, Sir Henry C. Mance and the like. Sir William Thompson is consulting engineer of the company.

William H. Preece, prominent electrician now in England and superintendent of the Government Postal Telegraph, in passing upon the merits of the above systems, says among other things: "The Julien and Sprague patents are of proved commercial value. They embrace the whole field of electrical power for general purposes, and there can be little doubt that their use of electricity for the transmission of power will, in the immediate future, still more rapidly extend the demand for electrical machinery. Large provision should be made for this branch of trade in the proposed extension of works."

English Telephone Combination.

The three great telephone companies of England have decided to amalgamate into a single undertaking. Their existing capital aggregates £1,620,000. Their new capital will be £2,465,000. The licenses of the present companies were issued by the post office department, to which was reserved the right to purchase their property in 1890. At the meeting at which the consolidation was almost unanimously resolved upon, the deputy chairman of one of the companies bluntly stated that "the proposed union would place them in such a position that when the time came for open competition—by the expiration of the patents—they would be able to defy not only the postmaster-general and his department, but any outsiders."

Slattery System in Baltimore.

The Waterhouse Electric Company, of Baltimore, Md., has been awarded the contract for lighting the new post office and United States Court rooms' building of that city, and they have contracted with the Fort Wayne Jenney Electric Light Company for the Slattery induction alternating system.

Messrs. McDonald and Adams, of the Fort Wayne Company, were in Washington and assisted in getting the contract for the Waterhouse Company.

The number of lights to be used is about 1,700, and the current will be supplied from the central station of the Waterhouse Company, who propose putting in a large number of lights.

* * The books for subscription to the Sumter Electric Light Company, of Sumter, S. C., were opened on Saturday at the Simonds National Bank. About one-half of the stock has already been informally subscribed. The projectors of this enterprise hope to be ready to turn on the lights by Sept. 1.

* * Parties representing a large electrical manufacturing establishment, located at Cincinnati, Ohio, are reported as being in Dallas, Tex., negotiating for a location to move their entire plant there. They manufacture motors, electric appliances, etc. The cost of the building and value of machinery will exceed $150,000.

* * It is reported that an electric railroad will soon be in operation between Fountain Square, Cincinnati, and Carthage, by way of the Zoological Garden. Should business prospects warrant, it will probably be extended further up the Millcreek Valley, possibly to Glendale. The valley is already a string of pretty suburban villages, and population is rapidly increasing.

* * The following officers have been elected to operate the Jamaica Plank Road Electric Railroad, which was bought to be operated in conjunction with the Kings County elevated railroad, giving it a through route to Jamaica: President and manager, S. S. Spencer, formerly president of the Baltimore and Ohio Railroad; secretary, H. Schermerhorn; treasurer, C. D. Bromley; superintendent, William M. Scott.

* * It is said that the directors of the Citizens' Passenger Railway Company, at Baltimore, are getting options from the stockholders for a syndicate who have agreed to purchase the stock within 30 days from June 19, 1889. The price to be paid is $40 a share, which is double its par value. There are in all 25,000 shares and it is stated 12,000 of them have been secured. The new company would probably establish a rapid transit system.

* * A recent dispatch from Richhill, Mo., says: The City Council at its meeting last night passed an ordinance granting a 20-year franchise to the Richhill Electric Railway and Light Company. The company agrees to construct and operate an electric railroad from here to the mines, a distance of five miles, and also furnish the city with electric light. The city guarantees a five per cent. dividend on the necessary amount to construct it, viz., $50,000. It is the intention to have the road in operation by the 1st of September next.

A Severe Test.

The electric cars were heavily taxed to carry the people to and from Vanderbilt University last night, says the Nashville *Banner* of recent date. In going up the hill between McNairy and Belmont a motor gave out, and the car could not proceed with such a heavy load. In a few minutes another car came along loaded to its utmost capacity, drawing a mule car, which was also heavily loaded, but it moved up against the front car and carried the whole load up the hill.

"Arc Electric Lights" is the title of a new little pamphlet by Mr. C. C. Haskins, city inspector of electric lights of Chicago. The book is written in Mr. Haskins' interesting style, and from the first paragraphs, relating to simple experiments, through the easily comprehended descriptions of the whys and wherefores of the electric light, and to the close, where Mr. Haskins gives some facts concerning Chicago's arc light system, the reader's attention is closely held. The book is issued by the Central Electric Company, of Chicago.

* * The Electric Railroad Company, of Salt Lake City, is busy laying the massive engine beds in the new power house on Second South street. These beds are forty feet square and nine feet deep. The four boilers are up, and the dynamos ready to be set in position. The power house and machinery represent an expenditure of $40,000.

* * The Union Electric Light and Power Company, of Lansingburgh, N. Y., has decided to begin canvassing for subscriptions for commercial light. When 400 subscriptions have been obtained the company will begin to furnish commercial lights, regardless of street lights. The company also decided to exhibit a system of arc lights as soon as a dynamo can be located and wires strung.

* * The Omaha Motor Railway Company, after two years litigation and conflict with rival corporations, is nearly ready to be put in operation with the Thomson-Houston electric system. The largest power station which has yet been constructed for electric railway operation is owned by this company, and the car equipment ranks second in quantity among electrical railways yet constructed, it having 26 motor cars, all of which will be used to tow at least one additional tow car, and many of the motor cars will tow two additional cars. The success of the Thomson-Houston system on the Omaha & Council Bluffs line has made the citizens of Omaha jubilant at the immediate prospect of such rapid transit being given them over their entire city. In addition to the equipment ready to be put in the company intend to add 20 additional motor cars upon the extensions of its system within a few months.

* * The popularity of electric railways is evidenced by the recent purchase of the Des Moines Broad Gauge Railway, equipped with the Thomson-Houston system, by a wealthy Chicago syndicate, the purchasing price being $350,000, some three times the original cost of the road. When equipped with horses this road did not pay operating expenses, but since its equipment and operation under the Thomson-Houston system, its net earnings will pay three per cent. dividends upon an investment of nearly $400,000. The road has never had a repair shop for its electrical apparatus, and in a recent conversation its president said that they did not know what electrical repairs meant, as they had had none to make. In some respects the Des Moines road has been the most wonderful in results of any electrically equipped road, it having at its power station but one 80 horse-power generator, which operates eight cars over grades running as high as ten per cent., without indications of overheating, and frequently tow cars are used with those equipped with motors. On one branch of the system the necessity of speedy equipment compelled the use of a No. 2 copper wire without feeders, such wire being the only available material, yet with this small conductor the cars are run at a rate of six miles per hour up a ten per cent. grade, three miles distant from the station.

* * The National Traction Company, of Detroit, begins the construction of an electric railway between Ishpeming and Negaunee this week.

* * The Boston *News Bureau* reports that the contract between the West End road and the Thomson-Houston Company for the electrical equipment of the street railways of Boston, was signed last Thursday.

* * The cottage in the village of Lazzatein which Alessandrio Volta spent the summer and autumn months for so many years, pursuing the investigations which resulted in the discovery of the Voltaic pile, has been secured as public property.

* * The Elevated Railway Company of Kansas City, Mo., has finally decided to employ electricity as a motive power on one branch of their system. The electric line will be from the Union depot to Riverview station, and from there to the end of the Riverview cable line.

* * The die is finally cast, and the franchise to allow the erection of poles and the operating of an electric street railway was granted by the city council to the Troy and Lansingburgh Company. Every citizen who has the welfare of the whole section at heart will rejoice at this consummation, says the Troy *Telegram*.

* * Manager Conklin, of the Grand Opera, has closed a contract with Prof. F. D. Badt, of Chicago, for the erection of 20 arc electric lights around the Syndicate block, beginning at Fifth street and going around the building to the alley on Sixth street. The lights will be 2,000 candle power, 14 feet high and 20 feet apart.

* * The Westinghouse Electric Company, since June 6th, have received orders for alternating current central station outfits, as follows: Nashville, Tenn. (increase), 750 lights; Sterling, Ill., 1,000 lights; Butte, Mont., 750 lights; Denver, Col. (increase), 1,700 lights; New York Safety Light, Heat and Power Co. (increase), 6,000 lights; Pottsville, Pa., 1,500 lights; Texarkana, Texas, 750 lights; Kankakee, Ill., 750 lights; Mexico, Mo., 750 lights; Stapleton, S. I., N. Y. (increase), 750 lights.

* * Work on the Lindell Railway Company's electric extension, from Twenty-third street and Chouteau avenue to Forest Park, St. Louis, is progressing very favorably, and with certainty of receiving material there is now no doubt that the line will be ready for operation by September 1. The contract calls for the completion of the line by that date, and the work includes the laying of two and a half miles of double track, with overhead wires strung on iron poles.

* * Mr. Henry Osborne of the American Telephone and Telegraph Company, has been in Fishkill Landing, N. Y., on business looking to the connection of Newburgh with the outside world by long distance telephone. The company's lines run along the Harlem railroad, and Mr. Osborne is investigating the feasibility of making connections with Manhattan and Fishkill and by cable to Newburgh. To establish their service in Newburgh requires a guarantee of business to the amount of $150 a month.

* * The Jeffrey Manufacturing Company of Columbus, Ohio, have perfected and are now manufacturing an electric coal mining machine, which is working successfully. It uses current at 220 volts pressure only, and undercuts from 500 to 600 square feet of floor per diem of ten hours. The Ohio State *Journal* says of it: "The advantages of electricity over compressed air are so numerous that the adoption of the new method is immediately assured, as one plant, which can be operated at two-thirds the expense of the old system, will light the mine and haul the coal, besides the economizing of compressed air pipes, which are succeeded by a copper wire. Again there is a big saving of power, as through the old method not more than 50 per cent. of energy worked the machine, while with the new fully 90 per cent. can be relied on."

Mr. Herman Hollerith, of Washington, described his electric tabulating system before the Labor Statisticians' Convention at Hartford, Conn., last week.

Electric light and power will produce more changes in the mechanical servants and conveniences of civilized life than has ever been caused by the use of any other method or force which has been subjected to the service of man.

During the recent disaster in Pennsylvania the mills of the Wyckoff Pipe Company, of Williamsport, were flooded seven feet. Through the energy of the proprietor, Mr. F. T. Wyckoff, the mills are now in running order, and orders are being filled on short notice.

The city of Waterloo, Iowa, has granted a franchise for the operation of all its street car lines by electricity. The longest electric road in Iowa is projected. It will thus be seen that the "meeting of its Waterloo" by electric power has not the meaning generally attributed to the expression.

The REVIEW's desk is ornamented with a paper weight, just received from the Ansonia Brass and Copper Company, of a novel design and composition. It is a miniature propeller of four blades, made of the now well known Tobin bronze which has been so successfully applied to the building of large propeller blades for practical use.

The puzzling freak of the lightning striking the woolen factory at Oxford, Me., without injuring it is explained by a local scientist as follows: He says so much electricity is generated in such factories that it dissolves any lightning that comes near it. He claims no instance is known of lightning striking a woolen mill to do any injury when the machinery is in operation.

At a recent meeting of the National Galvanic Battery Company at Cincinnati, the following new officers were elected: President, J. R. Murdoch; vice-president, W. E. H. Marsh; secretary and treasurer, M. T. Watts. Mr. E. G. Main, the eastern representative of the company at 18 Cortlandt street, is meeting with much success in increasing the business of the company in his territory.

At a recent meeting of the San Francisco Electrical Society, Mr. W. W. Hanscom, the chairman, was asked to give the society some information about telephones, which he did. Among other things, he said: "With the Blake transmitter, used by the Bell company, only one battery cell can be used, as more will burn out the carbon button. While chief telephone director in Peru, I discovered a means of preventing this burning while using 37 cells, and talked 780 miles over the telegraph wires therewith. As the Bell Company cannot use this under their contract with Blake, I will not patent it until their patent runs out. If any of you can discover my method—a very simple one—in the meantime, he can probably make a fortune."

Mr. H. M. Stevens, of Boston, says the New York *World*, is another "expert" who does not believe that electricity can execute a criminal. Mr. Stevens informed a correspondent on Saturday that he once slipped while inspecting an electric light plant, threw out his hands, accidently grabbed the positive and negative brushes of a dynamo exuding a current of 1,500 volts, was prostrated, dropped off by his own weight, had two doctors at work on his cold, stiff and pulseless body, and for three hours declined to become conscious. Why? Because he was "full of electricity and insulated." An attendant suggested putting him on the damp ground so that "the electricity could run out." This was done. The electricity "ran out" and Mr. Stevens rapidly recovered and grew fat, but remained a sort of dynamo, and still is very sensitive when thunderstorms are approaching.

The REVIEW is pleased to acknowledge the receipt of a new device to deaden the sound and improve the touch of that indispensable adjunct of every office, the typewriting machine. The United Rubber Company, of Trenton, N. J., have gotten out a patent rubber mat upon which the machine rests, and which, from a practical trial, seems to accomplish the desired result.

The Ball Engine Company, of Erie, Pa., in addition to their large trade in furnishing electric light engines, are having quite a demand for engines for operating electric street railroads, and have furnished the following roads with engines: Austin Water, Light and Power Company, Austin, Texas; Highland Park Electric Railway Company, Detroit, Mich.; Eckington and Soldiers' Home Electric Railway Company, Washington, D. C.; South Side Street Railway Company, Cleveland, Ohio; Central City Passenger Railway Company, Louisville, Ky.; Mt. Auburn Incline Railway Company, Cincinnati, Ohio; Cincinnati Street Railway Company, Cincinnati, Ohio; Akron Electric Railway Company, Akron, Ohio; Erie City Street Railway Company, Erie, Pa.; Melbourne Exposition Electrical Tramway, Melbourne, Australia; Box Hill and Doncaster Electrical Tramway, Melbourne, Australia; Binghamton Electric Railway Company, Binghamton, N. Y.; Lynn Electric Railway Company, Lynn, Mass.; Electro-Automatic Transit Company, Baltimore, Md.; Buffalo Street Railway Company, Buffalo, N. Y.; New Birmingham Street Railway Company, New Birmingham, Texas; Vandepoele Electric Street Railway Company, Windsor, Ont.; Atlantic City Street Railway Company, Atlantic City, N. J.; Williamette Bridge Street Railway Company, Portland, Oregon; Metropolitan Passenger Railway Co., Portland, Ore.; Bay Ridge Reservoir Company Electric Railway, Bay Ridge, Md.

The Edison United Manufacturing Company may well be proud of the following list giving sales of plants during May: Roanoke Elect. Lt. Co., Roanoke, Va., central station, 1,000 lights capacity; American Glucose Co., Buffalo, N. Y., glucose works, 1,000 lights capacity; Hackensack El Lt. & P. Co., Hackensack, N. J., central station, 650 lights capacity; Union Iron Works, San Francisco, Cal., steamer "San Francisco," 1,200 lights capacity; Gloucester Ferry Co., Philadelphia, Pa., steamer "Sylvan Glen," 75 lights capacity; Estey Organ Co., Brattleboro, Vt., organs, 20 lights capacity; J. A. & G. A. Stevens, Lake Placid, N. Y., hotel, 225 lights capacity; Bluffton Land, Ore & Furnace Co., Bluffton, Ala., foundry, 115 lights capacity; U. S. Government, West Point, N. Y., Military Academy, 75 lights capacity; Capital City Oil Mill, Baton Rouge, La., oil mill, 115 lights capacity; Silver Plate Cutlery Co., Birmingham, Conn., silver plate ware, 40 lights capacity; Portland Hotel Co., Portland, Ore., hotel, 1,750 lights capacity; Krehl, Hauser & Co., Girard, Ohio, tannery, 40 lights capacity; Jos. Turner & Sons Mfg. Co., Cleveland, Ohio, woolen mill, 400 lights capacity; Sand Hill Hotel Co., Augusta, Ga., hotel, 200 lights increase; R. R. Wood, McCook, Neb., central station, 450 lights capacity; Phœnix Woolen Mill, Stafford, Conn., woolen mill, 75 lights capacity; E. G. Acheson, Pittsburgh, Pa., laboratory, 10 lights capacity; Central R. R. N. J., Jersey City, N. J., steamer "Sandy Hook," 225 lights capacity; N. Y. C. & H. R. R. R. New York, N. Y., railroad depot, 1,400 lights capacity; Brooklyn Annex Co., Brooklyn, N. Y., steamer "Butterfield," 75 lights capacity; John Schuette, Manitowac, Wis., central station, 1,800 lights capacity; Menominee El. Lt. Co., Menominee, Mich., central station, 75 lights capacity; Gloucester Ferry Co., Philadelphia, Pa., steamer "Sylvan Dell," 75 lights capacity; Woburn El. Lt. Co., Woburn, Mass., central station, 300 lights increase; Union Depot, Ogden, Utah, R. R. Depot, 150 lights increase; Elgin Watch Co. Elgin, Ill., watch factory, 5,000 lights capacity; Penn. R. R. Co., Altoona, Pa., shops, 225 lights capacity; Wm. Rockefeller, Tarrytown, N. Y., residence, 750 lights capacity; Clifton Mfg. Co., Clifton, S. C., mill, 750 lights capacity. The total is 18,265 lights capacity.

MANUFACTURING NOTES.

The Phœnix Glass Company is well represented in the far west just now by Mr. A. H. Patterson, who, according to latest Victoria, B. C., papers, was in that city at the Driard last week. Mr. Patterson barely escaped the conflagration at the neighboring city of Seattle, W. T.

The Electrical Supply Company, of Chicago, are handling the Fletcher insulators, switchers, wire holders, lamp hangers, steel proof pulleys, etc., and have issued a folder descriptive of, and with price lists of these specialties. Another folder just issued by this progressive company describes the new ball and socket insulating joints for which many advantages are claimed.

The Eddy Electric Manufacturing Company, from their office in Windsor, Conn., have issued a well gotten up pamphlet on "Electric Motors and the Transmission of Power by Electricity." The book contains carefully written articles on electric transmission in general, transmission of water power, transmission for central stations and gives an interesting description of the Eddy motors, with a few letters from the well pleased users of them.

The Pond Engineering Co., through their Omaha representative, have lately sold to Mr. R. R. Woods, of McCook, Neb., an 80 horse-power steam plant, consisting of Armington & Sims engine, boiler, feed pump and heater to run an electric light station. Through their Kansas City representative the Pond Company have lately sold to John W. Norton, of Kansas City, for the Vine street motor line, a steam plant, consisting of a 100 horse-power boiler and 80 horse-power Armington & Sims engine, with the necessary pipe work, pumps and heater, set up ready for operation.

The Wyckoff Pipe Company, of Williamsport, Pa., are sending large consignments of their wooden underground conduit pipes to Brooklyn, N. Y., to the Bell Telephone Company, of Philadelphia, to the Edison Electric Light Company, of Philadelphia, the Chesapeake and Potomac Telephone Company, Washington, D. C., and Baltimore, Md., Chicago Arc Light and Power Company, and to the Western Union Telegraph Company. A large number of smaller orders will place the conduit in all directions. The company is at present offering a special sale of some slightly damaged tubing which is, however, perfectly good for ordinary use.

The Thomson-Houston Electric Company reports the following sales of electric light central station plants: Kingston, N. Y., 1,300 incandescent; Austin, Maine, 30 arc; Santa Cruz, Cal., 300 incandescent; Roodsburg, Wis., 300 incandescent; Andover, Mass., 50 arc, 600 incandescent; Fremont, Ohio, 600 incandescent; Chelsea, Mass., 600 incandescent; Hoosick Falls, N. Y., 600 incandescent; Kansas City, Mo., 400 incandescent; St. Paul, Minn., 100 arc, 300 incandescent; Mitchell, Dakota, 30 arc; Janesville, Wis., 45 arc; and the following isolated plants: Northwestern Cold Storage and Ice Co., Portland, Oregon, 30 incandescent; George L. Keith, Campello, Mass., 650 incandescent; Ottawa House, Portland, Me., 380 incandescent; Int. Telephone District and Construction Co., Baltimore, Md., 1,300 incandescent.

The economic value of electric light and power can not be developed to the point of greatest benefit to the users of electric service by inventors and manufacturers alone. The realization of the advantages of electricity by the people now depends more largely upon the economic conditions fixed for its production and distribution by state and municipal legislation than upon any other factor in the problem.—*Economic Value of Electric Light and Power.*

ELECTRICAL PATENTS

INDEX OF INVENTIONS FOR WHICH LETTERS PATENTS OF THE UNITED STATES WERE GRANTED IN THE WEEK ENDING JUNE 25, 1889.

405,738 Art of preparing elements for secondary batteries: William W. Griscom, Haverford College, Pa., assignor to The Electrical Accumulator Co., of New York.

405,742 Electrolier; John M. Orford, Bridgeport, Conn.

405,743 Regulator for dynamo-electric machines: James H. Robertson, Rutherford, N. J., assignor of three-fifths to Theron A. Richards and John Robertson, Brooklyn, N. Y.

405,750 Standing contact arm; Charles J. Van-Depoele, Lynn, Mass.

405,751 Secondary battery; Jean T. Van Gestel, New York, N. Y.

405,767 Conduit for cable or electric railways; William J. Brewer, New York, N. Y., assignor of three-fifths to Thomas W. Rae, Frederick H. Reed, Walter Thompson and George N. McGibbin, all of same place.

405,815 Electrical railway signal; James C. White, Sewickly, Pa.

405,831 Electric signaling system; Mark W. Dewey, Syracuse, N. Y., assignor by direct and mesne assignments to the Dewey Corporation, same place.

405,858 Electro magnetic motor; Nikola Tesla, New York, N. Y., assignor to the Tesla Electric Co., same place.

405,859 Method of electrical power transmission; Nickola Tesla, New York, N. Y., assignor to the Tesla Electric Co., same place.

405,867 Telephone-exchange apparatus; Franklin G. Beach, Chicago, Ill.

405,895 Combined track and train lighting; Harry W. Leonard, Chicago, Ill.

405,896 Electric lighting system; Harry W. Leonard, Chicago, Ill.

405,897 System of electric lighting for railway cars; Harry W. Leonard and Augustus Hanson, Chicago, Ill; said Hanson assignor to said Leonard.

405,906 Electric arc lamp; Henri Pieper Fils, Liege, Belgium.

405,964 Automatic electric controller for railroad trains; Erank E. Kinsman, New York, N. Y.

405,970 Adjustable support for incandescent electric lights; John T. Pearson, St. Louis, Mo., assignor of one-half to Harvey S. Page, same place.

405,978 Electrically-propelled vehicle; Richard N. Allen, Cleveland, O.

405,984 Telegraphy; Charles G. Burke, Richmond Hill, assignor to Frederick Wolffe, trustee, New York, N. Y.

405,985 Telegraph instrument; Charles G. Burke, Richmond Hill, assignor to Frederick Wolffe, trustee, New York, N. Y.

405,986 Telegraphic instrument; Charles G. Burke, Richmond Hill, assignor to Frederick Wolffe, trustee, New York, N. Y.

405,987 Telegraphic instrument; Charles G. Burke, Richmond Hill, assignor to Frederick Wolffe, trustee, New York, N. Y.

405,988 Telegraph instrument; Charles G. Burke, Richmond Hill, assignor to Frederick Wolffe, trustee, New York, N. Y.

405,989 Telegraphic instrument; Charles G. Burke, Richmond Hill, assignor to Frederick Wolffe, trustee, New York, N. Y.

PROPOSALS for the construction and erection of a Police Patrol Telegraph and Telephone System. Office of the Commissioners, D.C., June 27, 1889.

Sealed proposals will be received at this office until 12 o'clock, M., on Monday, July 15th, 1889, for the construction and erection of a Police Patrol Telegraph and Telephone System in the City of Georgetown, District of Columbia.

Blank forms of proposals and specifications can be obtained at the office of the superintendent of the Telegraph and Telephone Service, cor. 5th and D Sts., N. W., Washington, D.C., upon application therefor, together with all necessary information, and bids upon these forms only will be considered.

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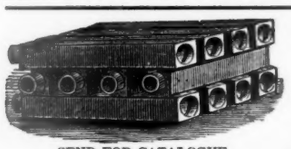

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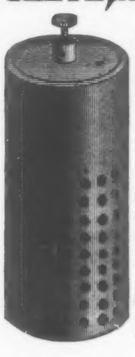

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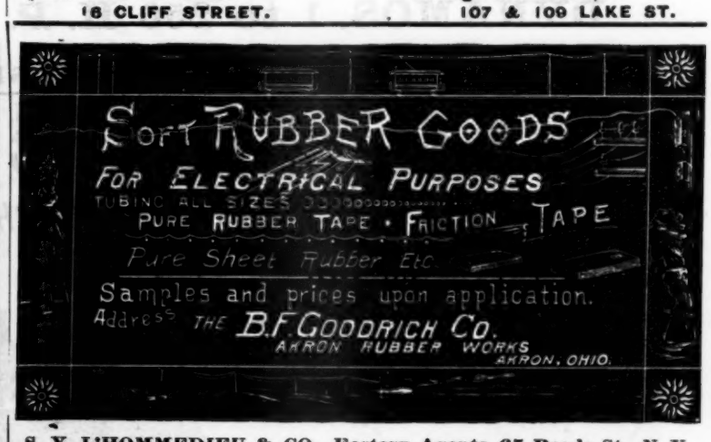

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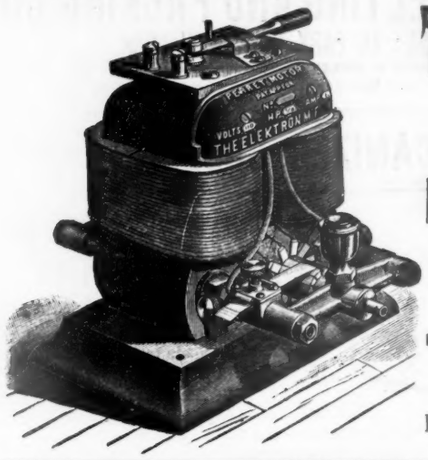

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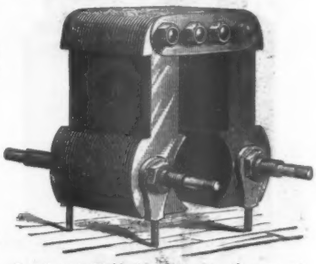

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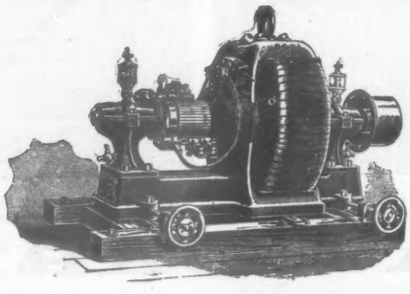

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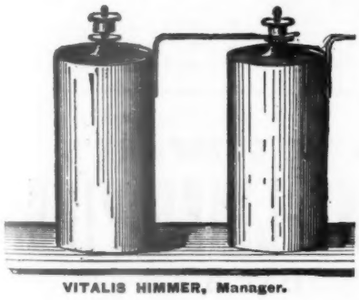

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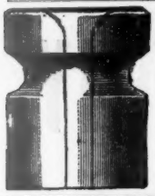

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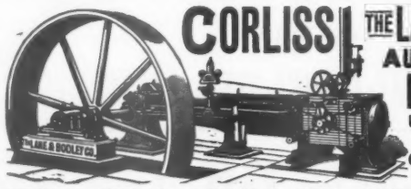
The volume deals with the Arc and Incandescent Light, the relations of Electricity and Gas, the Electric service of Cities, Electric Motors, and other applications of the new power. Much of the information afforded is in the shape of practical essays by well known specialists in Electro-Dynamics. Other questions discussed are Municipal Ownership of Commercial Monopolies, Municipal Management of Manufactures, State and Municipal Legislation, Economic Aspects of Trusts, and Joint Stock Associations. The volume contains also, a valuable appendix, in which mechanical and electrical terms are explained in untechnical language. The work is designed principally to benefit those interested in obtaining municipal franchises, promoters of Electrical enterprises, and manufacturers of Electric Supplies, Motors, Machinery, etc. Its general interest, however, should make it a popular publication.



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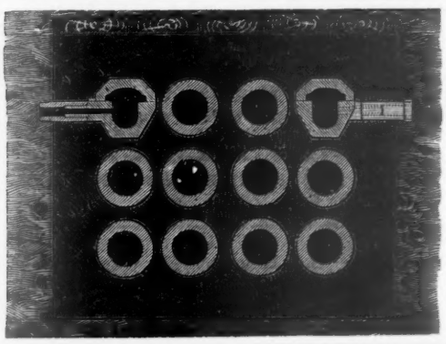

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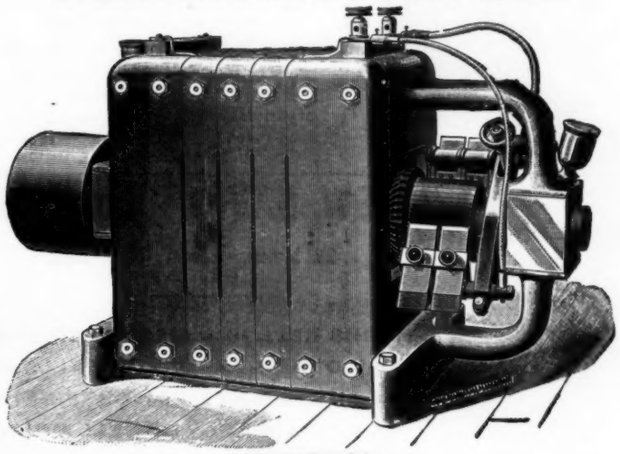

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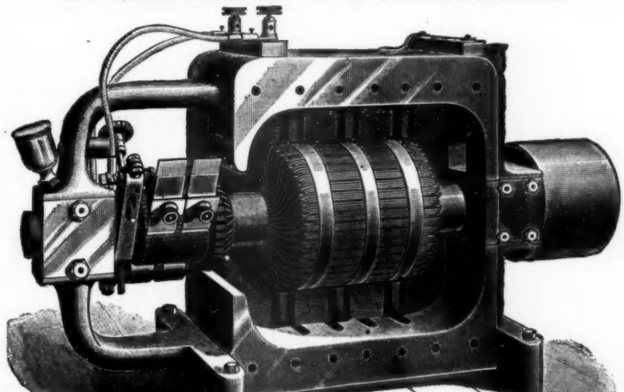

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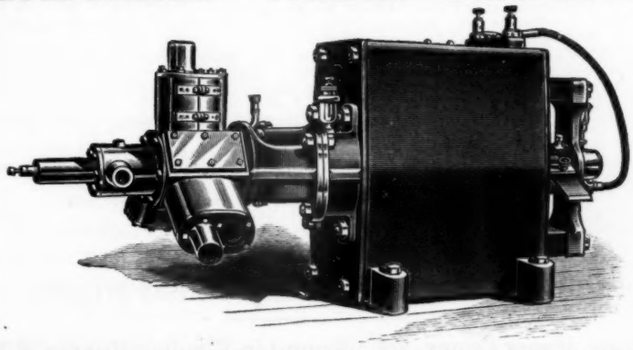

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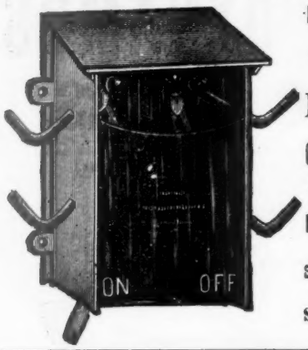

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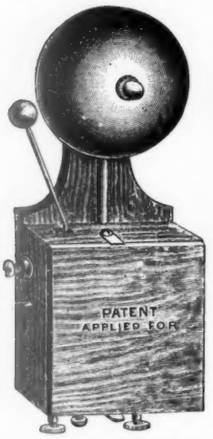

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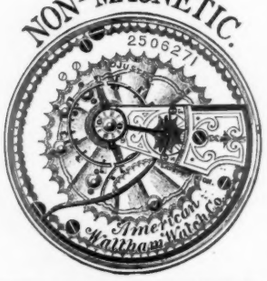

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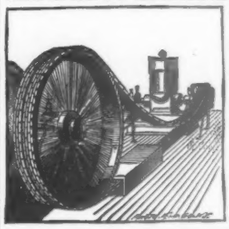

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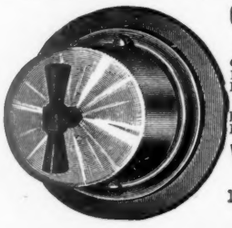

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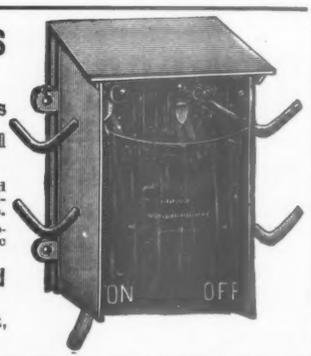

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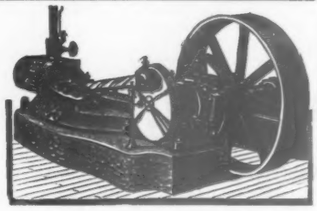

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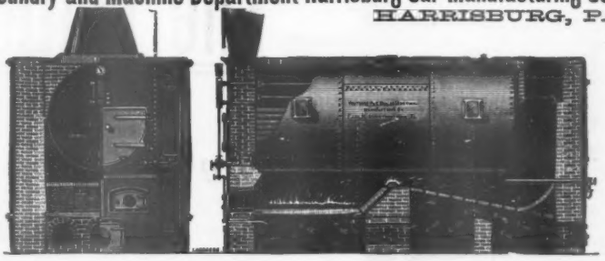

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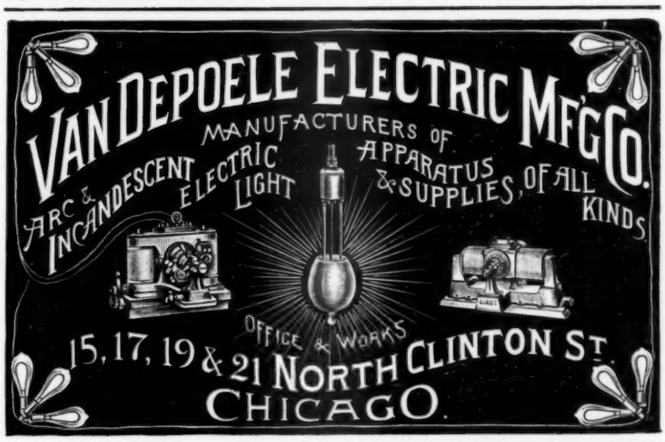
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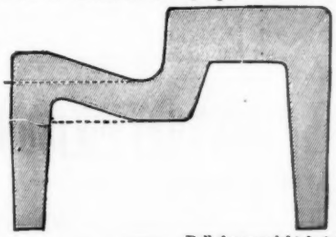

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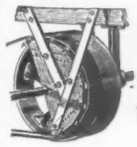

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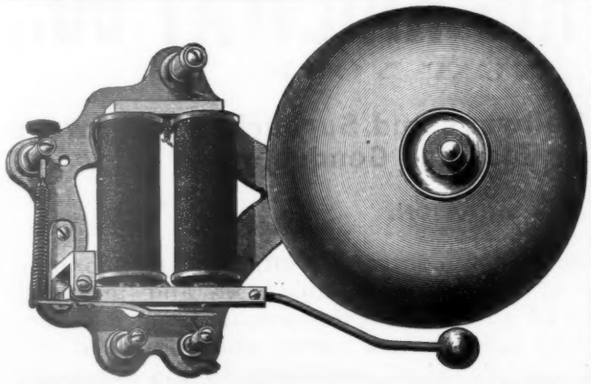

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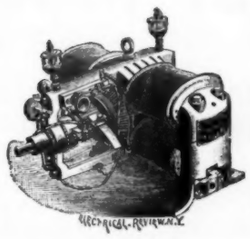

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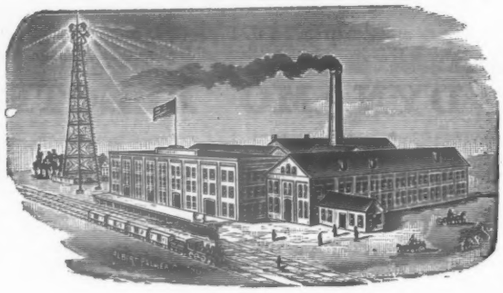

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